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METAL PROBLEMS IN THE CONTAINER FIELD

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The object of this paper is to state in an orderly manner the author's analysis of the various mechanical and physical properties metallic materials must have to function well in glass forming and handling equipment. These remarks apply only to equipment used in blow ware or press and blow ware. The metallurgical problems of pressed ware are to be presented in another paper by another author. No attempt will be made to name the best material for a specific part. The reason for this is that there is usually more than one correct answer. Many factors other than the material itself enter here and will vary from plant to plant. Availability and cost of the material, tooling necessary to fabricate or repair the parts, operating characteristics of the forming machine, and nature of the glass used all play an important part in the selection of material. The ultimate measure of success in specifying metals is the cost per gross of quality ware.

Feeder Parts

If we start at the feeder and work down, we can consider parts or groups of parts one after another. The actual need for a metal orifice ring is controversial. Granted that a metal ring is needed, the property required is a metal that is completely stable under glass. There must be no color imparted to the glass if minute particles are abraded away. Word of mouth reports are that platinum has worked very well here. The disadvantages are easy damage by stones and mechanical damage in removing the ring from its supporting ceramic block when the block is worn out. Material for shears must be light in weight, abrasion resistant, and stay sharp even though the cutting edges are exposed to fairly high temperatures.

Entirely different properties are needed for scoops, troughs, deflectors, and funnels. These, too, should be light in weight. They must not mark the gob. Consequently, the need is for a material capable of maintaining a very smooth surface or holding a coating which is very smooth. Because the glass rides a film of oil or graphite thermal conductivity is not a problem.

Bottle Machines

A bottle machine consists of *frames*, on and in which are supported shafts, bearings, cams, rollers, gears, etc. Like all other machinery, they require stiff frames with good damping characteristics, shafts that are tough, bearings that are large enough to support the load. Cams usually need a hard abrasion resistant surface. Rollers that ride these cams must be hard with high impact strength. Because these machines must operate continuously, it is essential that all parts must be selected with fatigue failures guarded against. Indexing machines are apt to set up vibrations which require extra strong fittings on pipe lines. Air cylinders and trip valves are subject to corrosion from wet air. Lubrication is not always adequate to prevent this. Materials with stainless properties are indicated for this service. Some parts of bottle machines operate at fairly high temperatures. Because of this, aluminum and magnesium are usually excluded from consideration because of the rapid drop in strength as temperatures rise. The low melting point of these materials is also a disadvantage. This is particularly so on the Owens machine where parts of the machine are above the pot level. There is need here for a light, strong metal with a high melting point. Perhaps titanium will fit in here when it passes out of the laboratory stage.

Bottle Handling

The metal requirements for bottle handling equipment from take-out tongs to lehr mats narrow down to simple abrasion resistance. Checks are controlled by avoiding large temperature differentials between glass and metal, with minimum area of contact surfaces. Aluminum wire

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transfer belts currently are being pushed by one woven wire belt manufacturer.

Mold Materials

For mold materials there is a long list of desirable characteristics. They are: good machinability, a polishable structure, low expansion, resistance to heat checking, good thermal conductivity, resistance to scaling, resistance to abrasion and impact, low cost. Various combinations of these properties occur in plain and alloyed cast iron, in alloy steels and in aluminum bronze. In general, it is necessary to compromise somewhere. It is this writer's belief that for most jobs one can get best performance for the least cost in cast iron.

By good machinability is meant a material that can be cut at high speeds without coolant, and produces a short chip. Massive carbides and islands of steadite must be very few and preferably absent. Good machinability is essential for fine hand or machine cut decorations. A brittle iron cannot be repaired along the seams by stoving.

A polishable structure is one that can be smoothed easily to within a few microinches when measured with a profilometer. The coarsest flake of graphite, if graphite is present, must be smaller than the naked eye can see.

Low expansion also covers low permanent growth. Most mold equipment cycles through the transition temperature normally found in ferrous materials. The need here is for abnormally low or abnormally high transition temperatures. One way lies austenitic iron with high expansion. The other way lies material sensitive to shock or difficult to machine. Another out is to stabilize the carbides, but to accomplish very much this way leads to hard irons difficult to machine.

Resistance to heat checking is needed wherever heavy walled parts are subjected to rapid fluctuations of temperature at fairly high levels. This situation occurs in relatively few mold parts but materially shortens the life of the part when present.

High thermal conductivity is desirable to carry away the heat absorbed from the glass and thus permit high operating speeds without sticking. In this connection it should be pointed out that it is not a simple problem to change to a very high or very low conductivity material on a machine designed for cast iron molds. The cooling time and wind ducts built in the machine present considerable obstacles.

Resistance to abrasion and impact are needed principally in flow machine neck rings. A way to form a ring economically and harden it without dimensional change is a definite problem.

The points discussed above are more ably covered by a very fine paper by James Vanick of the International Nickel Co., published in THE GLASS INDUSTRY in 1938.

In considering cast iron only, there are two schools. Some people favor the high combined carbon types with small graphite flakes, while others are content only with very low combined carbon and the typical structure of chill cast iron. Resistance to heat checking, permanent growth and polishability vary between wide limits in these two kinds of cast iron. The kind of service required from a plunger is different than that of a blow mold. The kinds of material for a plunger are influenced by the type of cooling. Irons sensitive to thermal shock can be used on air-cooled plungers but fail miserably in water-cooled applications.

Stainless steels and aluminum bronzes are special purpose materials and should be used where their special characteristics can be used to full advantage.

In conclusion, it appears that the metal problem for the container industry is to obtain a low cost, easily machined and polished material that is stainless in nature, abrasion resistant, and has a fairly high thermal conductivity.

INTERNATIONAL COMMISSION ON GLASS MEETS IN SWITZERLAND

Glass scientists from seven countries were in Berne, Switzerland July 10 and 11 for a meeting of the International Commission on Glass. The American Glass industry and the American Ceramic Society were represented at the meeting by Howard R. Lillie, research physicist for Corning Glass Works, who is President-Elect of the Society. Other American Commission representatives, who were not present at the meeting, are F. C. Flint of the Hazel-Atlas Glass Co., Donald Sharp of Libbey-Owens-Ford Glass Co., and George W. Morey, Geophysical Labs., Washington, D. C.

A Constitution was approved for the Commission, fixing the membership of the Commission and methods of choosing representatives from the various countries which do not have a representative technical organization. The following officers were approved: W. E. S. Turner, England, President; Bernard Long, France, Vice President; B. P. Dudding, England, Secretary; W. M. Hampton, England, Treasurer; and J. C. Hostetter, United States, and H. Maurach of Germany, Honorary Vice-Presidents.

With the organization of the Commission out of the way, reports were given on a varied program of activities. Work on a list of periodicals in the glass field has been started by the Deutsche Glastechnische Gesellschaft, and was reported to be in first draft.

The Society of Glass Technology (British) is conducting a study of the efficiency of glass tanks. They reported continued activity and that some material had been published. Other studies which have been started are on the effect of iron oxide in glass and a survey of glass annealing in theory and practice.

Proposed Commission projects discussed included the setting up of international standards and specifications in glass, exchange of material on test methods and standard glasses, and an international journal.

It was recommended that the next meeting of the Commission should be at Paris around June 1, 1951. Dr. Lillie was named to the Commission's Executive Board, which will meet in Belgium in November

The Commission is made up of the following organizations and institutions: The American Ceramic Society; Ceramic and Glass Society, Czechoslovakia; Deutsche Glastechnische Gesellschaft, Germany; Society of Glass Technology, England; Union Scientifique Continentale du Verre, France; Institut du Verre, France; Institut National du Verre, Belgium, and Stiftelsen Glasinstitutet i Vaxjo, Sweden. J. A. de Artigas was chosen representative for Spain, E. Borel for Switzerland, and a representative was also named for Italy. Individual members chosen are A. H. M. Andreassen, E. Hald, and George W. Morey.

NEW TYPE OF PRESSURE-TESTING MACHINE FOR BOTTLES

This new electronic, increment-pressure, automatic device answers the problem of pressure testing varied types of glass containers produced in quantity

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Editor's Note: The following paper briefly reviews the history of pressure testing, present-day requirements, and an outline of the new pressure-testing equipment developed at Preston Laboratories.

It is hoped that at a later date a more complete story on the equipment and its performance under actual service conditions can be published.

Mr. Delgado, Editor of THE GLASS INDUSTRY, has been putting a little pressure on me to describe this machine, which was demonstrated at the Glass Container Manufacturers Institute meeting at White Sulphur Springs last May, and in all probability will be shown again at the Toledo meeting of the Glass Division of the American Ceramic Society in October. I have felt that I could not give a full description of it because, although it has been under development for five or six years, it is still evolving and may even yet not be in its final form. Nonetheless, I feel that we should go along with the Editor to the extent of saying what the history of the development has been, and what is its purpose.

The first really satisfactory pressure-testing machines that met with general acceptance by the industry were those this Laboratory developed almost twenty years ago, principally at the prodding of Mr. George Meyer of the Glenshaw Glass Company. What was wanted most in those days was a device for testing the pressure strength of "siphon" or "seltzer" bottles. These bottles are subjected in service to very high pressures, and if not good sound bottles, unpleasant accidents might occur. In general there is an adequate margin of strength, but it is desirable to be sure of it. The rate of production is strictly modest, and it is practicable, with some effort, to test every bottle. In such a case the pressure used should not greatly exceed the working pressure, according to European tradition, though the tradition may not be applicable in every respect to modern conditions. The duration of the test, however, must be specified, and the test-pressure must be scientifically correlated with the test-duration.

Before this was all straightened out, a good deal of careful experiment, amounting in fact to research, had to be done. So far as machinery is concerned, the result was the electrically-timed single-head hydrostatic-pressure machine, and the 4, 6, and 12 multiple-head machines, mechanically timed. These machines are now in general use here and abroad. They have several good points. Apart from being rugged and durable, they are able to deliver a very precise pressure and to hold the pressure very steady throughout the test. These factors are necessary for accurate work, and the pressure resembles the pressure that the bottle will be called upon to sustain in practice, viz., a steady long-drawn-out internal hydrostatic pressure.

In practice, however, it was not siphon or seltzer bottles that came in for most of the testing. There are many other sorts of bottles that must, in practice, be fit to hold pressure, though the pressure is usually lower, often much lower, than in seltzer bottles. These other bottles are made in relatively enormous numbers, they usually have a wide margin of safety, and it is neither necessary nor possible to test them all. A sample is sufficient.

As soon as we come to sampling, we begin to run into problems of statistics. We also begin to run into questions of what information it is, precisely, that we wish to extract from the testing.

When we were testing seltzers, we tested all of them. We used a pressure well above the working pressure and, in general, below the bursting pressure, though sometimes a bottle or two would break. But every bottle sold had been tested, and we could warrant to the purchaser that it had successfully withstood a pressure above the working pressure. When we were testing other bottles, we used similar procedures, and could normally warrant that out of a representative *sample* tested, no bottles broke at a pressure well above working pressures.

Now while this is as good a warranty as is normally available in any line of commercial articles, and is satisfactory from the purchaser's point of view, and the public's, it is not exactly what a bottle manufacturer wants, because it gives only a minimum amount of information. He knows his bottles are good *enough*, but he does not know *how* good they are. He does not know whether they are better than his competitors'; he does not know how much margin of strength he has; he does not know whether they are better than those he himself made yesterday, or a year ago; he does not know which of two or more machines makes the better bottles; he does not know which set of molds produces the best result, or which tank; if he has two plants, he does not know whether one is better suited than the other for a particular job. All these things might interest him, but all he knows is that the bottles are sound, and fit to be sold. This is vitally important, but it is not all he might with advantage know.

Further, as we have mentioned above, he runs into special problems of statistics when he operates a "pass-level" test of this sort and nothing else. But this, being a mathematical matter, we will leave alone in the present discourse. The matter exercised the minds of the members of the G.C.M.I. Committee on Testing Procedures, and all sorts of solutions were proposed and examined. I myself became convinced six or eight years ago that in all probability no complete solution could be found short of a new piece of testing apparatus.

As I saw it, it would be necessary to test to destruction all, or many, of the bottles comprising the "sample". This is a radical departure from "pass-level" testing, and it threatened to involve a great expense and a great expenditure of time, if done with the apparatus that had become conventional and standard. Some other apparatus would be required. It seemed to me that we needed

a device that would subject each bottle to a series of pressures, each higher than the previous one, each held very steady while it was held at all, and each held comparatively briefly—a matter of a very few seconds, but accurately timed. The machine was to indicate the pressure at any step, and to stop itself if the bottle broke, while still indicating the last pressure used. I came to the conclusion that in all probability all this could be done electronically better than mechanically. After Mr. McCormick had preceded General McArthur by a few hours at the assault landing at Leyte in the Phillipines, and not long afterward had been sent back to the U. S. A., I wrote him asking his opinion, since his knowledge of electronics greatly exceeds mine. He replied that he thought it could be done, and when he returned to the Preston Laboratories, he set out to do it. It proved more difficult than either of us had expected.

I shall not detail those difficulties. Months dragged into years. One model and then another was tried. Not all the difficulties were electrical. Mr. Dimmick was by this time doing most of the designing and experimenting, with Mr. McCormick's help and supervision. Finally we had what seemed to be a sound piece of apparatus.

When we could find nothing wrong with it, we got Dr. Ghering to give it a work-out. He also helped materially in so designing it that the theory of statistics could be applied to it with a minimum of trouble and a maximum of information. When we had him satisfied, we invited a manufacturer to send his testing personnel to Butler, together with a great stock of assorted bottles, and give it a harsher trial. This developed a few trifling difficulties, which were easily remedied. We then placed it for some weeks in the factory of another company, and then in that of a third company. In each case we learned something about the machine and the company learned something about its bottles.

The machine itself, in its present form, consists of a small box full of "radio" tubes and wires, and in one end of it is a hydraulic system of air and water pipes and valves. On the front of the box is a series of tiny lights arranged one above the other. A different light comes on with each different step of pressure, so some glass technologists whose spare time is picturesquely but not too wisely spent have referred to it as "the pinball machine".

There is, of course, a small mechanical part that clamps the bottle, and this resembles the present standard machine in suspending the bottle by the neck and not touching the base in any way, a necessary condition for simulative testing, but the clamps or neck rings are different in principle from those in existing machines. The toggle device that clamps the seal on the finish is also radically different.

The bottle, filled with water, is placed in the clamps and sealed manually, a very quick operation in this machine. This connects it with a part of the machine which itself is loaded with water, and a pressure-sensitive electrical device reports the pressure (which at this stage does not exceed faucet pressure) to the controller or "brain" of the machine. The starting button is pressed, and the "brain" calls for an appropriate starting pressure. The operator has previously decided what is an appropriate starting pressure and has set a selector switch accordingly. Perhaps it is 200 lb./sq. in., perhaps 320, since it is no use wasting time by testing at pressures far too low to break even a poor bottle.

When the "brain" calls for a starting pressure, nitrogen from a compressed-air-cylinder is admitted and in a fraction of a second the correct pressure is attained and maintained. The air is not in the bottle, but in the hydraulic system of the machine itself, which is in contact with the water of the bottle. This prevents the fragments of bottle from flying around when it breaks.

The bottle does not break at the starting pressure, so in three seconds the brain says "try 40 lb. more" and the machine tries it. At the same time a new light comes on to indicate what pressure is being tried. The brain keeps issuing instructions, and the machine keeps obeying them till the bottle breaks. This causes a sudden drop in pressure and a bodily movement of the water in the hydraulic system. The machine says to the brain, "The bottle has broken," and the brain says, "Hold everything." So it does not ask for any new pressure, but leaves the light burning at the last pressure that was used. The operator reads this pressure, throws out the neck of the broken bottle, examines the fragments if he wishes, and presses the "reset" button. Then he loads in a new bottle and the machine is ready to test that one.

A great deal of information can be quickly collected by this machine. There is already evidence that this information will be useful, and that the machine will meet with a good welcome. However, we are not quite ready to market it yet because we hope to check and double-check every feature of the machine under a variety of local conditions and to examine fully the statistical implications. This general account is written, as I said, under pressure from Mr. Delgado, (and others to a less extent), and may serve a useful purpose as a preliminary announcement. It may simplify the problem of describing the machine in more technical terms later and elsewhere.

G.C.M.I. FALL MEETING TO BE HELD IN CANADA

The 1950 Fall Meeting of the Glass Container Manufacturers Institute will be held at the Seigniory Club, Province of Quebec, Canada, on October 16, 17, and 18, according to an announcement by the Institute.

The schedule for the three days is as follows: Monday, October 16, and Tuesday, October 17, will be utilized for receiving semi-annual reports from the nine standing committees and making these reports available to the industry generally. The meetings on these two days will be under the auspices of Board of Trustees. On Wednesday, October 18, the semi-annual membership meeting will be held and is open only to glass container and closure manufacturers and allied and supplier companies who are regular members of the Institute.

A golf tournament has been scheduled for Tuesday, October 17. There is a swimming pool, tennis and horseback riding facilities. Several events have been planned for the ladies, including a bridge and tea on Monday, October 16, and a trip to Ottawa with luncheon at Chateau Lauriat on Tuesday, October 17.

WICKERED DEMIJOHN

By MARCEL LEFEBVRE

An English advertisement in American papers? It certainly reads like one. But it is entirely American.

The ad appeared in the *Vermont Gazette* of September 12, 1792. The four men whose names are listed as the owners of the store were probably successors to the original founders of the glass factory located in a small village near Albany, where Indians were employed by the glass firm, probably the first American Indians to contribute skilled labor in the manufacture of glass products.

Orders for window glass of any size and bottles from half-pints to five gallons, will be thankfully received and punctually executed at their glass store, Number 48 Market Street, Albany.

James Caldwell.
Christopher Batterman.
Robert McClallen.
Robert MacGregor.

N.B.—The following prices will be given for broken glass at the above store:

5 S per cwt. for black bottles.
8 S per cwt. for window glass.
10 S per cwt. for flint glass.

We present-day glass workers may marvel at the Oklahoma Indians' aptitude, and interest shown in modern glass plants. Some of us might even say that the Red Men, too, will develop silica-blood if they stay with it long enough. Who knows but what they've had that strain in their blood ever since their ancestors were employed by the industry to weave wicker-baskets to wrap around the five-gallon bottles.

We have probably been too prone to assume that only white men with old English, or Dutch, or French, or German names are glass workers by heritage.

It is quite true that many of us bearing such names are direct descendants of the first artisans to make glass in America. Those sturdy artists with the blow pipe, who came to America as chattels, were assigned for definite periods of labor to specific American employers.

Most of the early glass workers were brought from Europe in large groups. Entire crews, consisting of glassmaker, blowers, gatherers and finishers came together to man the plants. They signed contracts with the owners that bound them to work for no other employer for two, five, or ten years. When such an employee violated his contract by taking a prolonged walk to visit relatives, or a friend, the enraged employer would advertise the runaway in all the newspapers, and offer liberal rewards for his capture and return.

American manufacturers sent agents to England, Holland, France, or Germany to recruit skilled workers. They would select, sign-up, and transport to an American port, twenty-five or fifty men, and their families, at the manufacturer's expense.

Sometimes a ship would be chartered for the purpose. An entire shipload of glass workers—what an ocean crossing that must have been—probably made more and bigger bottles and rollers, fancier vases, and dishes on board ship than had ever been made in any factory.

One of the early firms to recruit, and sign contracts with such a group was the firm referred to relative to the foregoing advertising. The partnership consisted of Leonard DeNeufville, Jan Heefke, and Ferdinand Walfahrt. They organized in May 1785.

Heefke was sent to Germany to select twenty-five skilled glass workers to man the plant. He brought them to the settlement of Dowesborough (in what is now Guilderland Township, N. Y.). The plant was built and the men started blowing window glass and bottles in 1787. In those early days, bottles and window glass were usually made out of the same pot of glass by the same blowers.

Wood, of course, was the only fuel available. Therefore, the plants were built in locations surrounded by abundant forests. And as they tried to provide enough fuel supplies for the years ahead, the manufacturers were compelled to build tiny villages for their employees beyond the more settled areas. And that sometimes brought them within range of an Indian village or camp.

Such an Indian village was near the new village containing the glass factory and the residents of both settlements were deeply interested in one another's way of life.

Expert weavers for unknown generations, the Indians were soon encouraged to add that art to the white man's art of blowing huge glass bottles. And thus was born the wickered-demijohn. The huge glass bottle was almost entirely protected by the wicker basket that was to become the standard container of many different kinds of liquids for many years, all over the country.

The present Indian glass worker is nothing new. His ancestors contributed his know-how, just like your ancestor did, towards building the great industry we now enjoy.

PENNSALT REPORTS RECORD PROFITS FOR SECOND QUARTER

The Pennsylvania Salt Manufacturing Company has reported that net profits for the second quarter of its Centennial year, ended June 30, were $1,124,428 after taxes, again the highest net profits for any quarter in its 100-year history.

These profits are equal to $1.27 per share of Common Stock on 874,156 shares outstanding after provision for Preferred Dividends. During the quarter Pennsalt's Preferred Stock was called, more than 99 per cent being converted to Common, but preferred dividends were provided for in the quarter.

Net profits for the second quarter of 1949 were $715,261, equal to 89 cents per share of Common Stock, after Preferred Dividends.

Net sales for the second quarter of 1950 totaled $10,423,049, as compared with $8,547,255 in the second quarter of the previous year.

TV TUBE PRO N

With television set production this year estimated at between 7,500,000 and 9,000,000 sets, or twice the production rate of all prior years combined, TV viewing tubes are coming off the line at the Ottawa, Ohio plant

Fig. 1. Completed electron guns for television picture tubes require precise alignment of parts for proper operation of an electron optical system. Nearly 100 stainless steel parts must be carefully positioned and spot welded together. Finished guns shown above are electro-magnetic types which utilize an ion trap to eliminate screen blemish. Fig. 2. After the tube screens have settled on the conveyor, the liquid is automatically poured off and the bulbs are conveyed to a dryer. Foil caps are placed over the bulb necks to prevent possible contamination by airborne dust. This section of the Sylvania Ottawa plant is fully air-conditioned to assure controlled temperature and humidity conditions. Fig. 3. In applying screen material to both metal and glass tubes, a giant automatic conveyor system is used. The empty bulbs are thoroughly washed to prevent possible contamination of the fluorescent material which is later applied to the picture tube screen. After thorough drying, the bulbs are clamped on the conveyor and partially filled with a solution in which the fluorescent screen material is held in suspension. The bulb moves slowly toward the pouring end of the belt and the screen material settles out on the bulb face. Here the operator places empty glass bulbs on the conveyor and will remove the bulbs with settled screens. Fig. 4. Automatic sealing of the glass face plate to the metal cone is handled by high speed rotary equipment. During the operation, the metal cone and glass face plate are sealed together and tempered by passage through an oven. The operator is remov-

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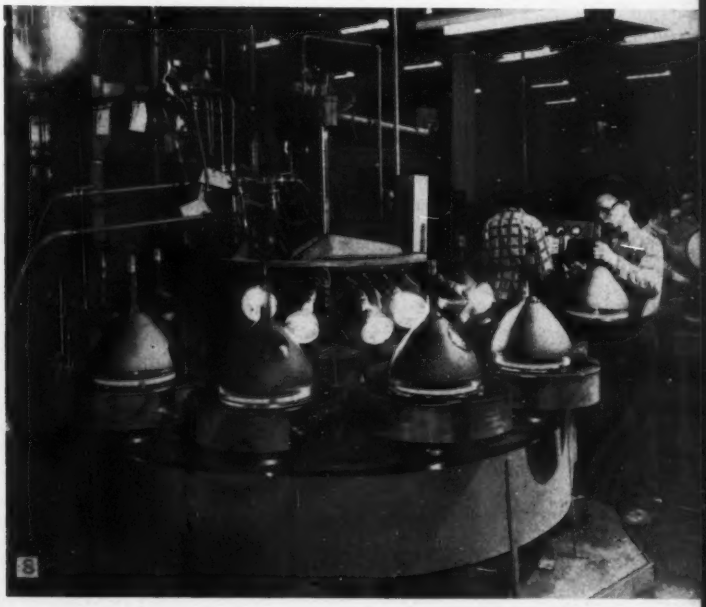
of Sylvania Electric Products, Inc. at an intensified rate of speed. Shown here are important steps in the mass production of Sylvania's glass and metal viewing tubes using heavy automatic equipment.

ing the completed bulb assembly, the face of which will be screened and further processed before the electron gun is sealed. Fig. 5. The operator is placing the television tube on a cart which will take it through the new straight line exhaust machine. The cart acts as a pump and the equipment in the cart feeds energy to it and to the bulb. Because individual carts can be rolled off this machine if one bulb needs repairing, it gives excellent control and does not delay tubes at other positions. Lights on the control board indicate the sequence so that an operator can tell what is happening to each bulb at any given moment. Fig. 6. Electron gun mounts and finished glass bulbs are sealed

together in an automatic rotary type machine. The operator is shown removing an assembled tube which is ready for automatic exhaust and processing. Fig. 7. To assure maximum dependable performance in television sets, operators check every tube coming off the production line by making precise measurements of all electrical characteristics and light properties of the screen. Final double check, after the tubes are cartoned, includes test of vacuum, emission, and inspection for physical defects before the lot is released for shipment. Here the operator checks cathode activity and process quality. Fig. 8. Practically all Sylvania glass television picture tubes require an outside graphite bearing coating which is sprayed on after the tubes have been completely processed. Infrared lamps dry the exterior coating as the tubes pass around the automatic rotary spraying equipment shown here.



AN ENGINEERING EDUCATOR CITES THE NEED FOR SAFETY ENGINEERING

By R. M. CAMPBELL, Department Head
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At the annual meeting of the American Society for Engineering Education, it was reported that but 28 colleges in the United States teach safety engineering. In the United States, 12 colleges provide a full four- or five-year undergraduate course in ceramics. From my observations and from my familiarity with the curricula as taught in these ceramic engineering institutions, no safety engineering, as such, is included in these courses.

The combined efforts of the National Safety Council, the American Society of Safety Engineers, the American Society for Engineering Education, and others are making the case of safety well known. Further promotional efforts are needed. It is my prediction that more and more schools will follow the trail blazed by the 28 colleges by insisting that engineers be better qualified to cope with safety problems. All graduating engineers should at least be acquainted with the fundamentals of safety engineering, as well as the rudiments of industrial hygiene. The teaching of safety engineering immediately suggests two different approaches to its fulfillment:

(1) A full-time course in safety engineering. This course would be based upon the fundamentals of mathematics, physics, and chemistry, the same "core" as in other branches of engineering, but the specialization would be in safety and in hygiene.

(2) Safety taught in conjunction with other engineering courses as now given; namely, chemical, electrical, civil, ceramic, metallurgical, etc.

It is to this second consideration that I wish to confine my comments. I wish to propose that safety and industrial hygiene be included in a course that would indoctrinate engineers into these subjects. Included at the same time, an indoctrination into the *ethics* and *practices* of the present-day engineering profession should be taught.

It is impossible for every engineering graduate to be familiar with all there is to know about all branches of engineering. For example: a ceramic engineer cannot devote as much time to structural design as would a civil engineer. The graduate in ceramic engineering, however, should know the fundamentals of the resistance of materials and of structures in order to work intelligently with the civil engineer. The same analogy can be made with the ceramic engineer's grasp of the fundamentals of electricity, of business administration, of industrial engineering, and now, of safety engineering and industrial hygiene.

The objectives of engineering education during the past few years have been largely guided by the Hammond Report,[1] which was made in 1940. H. P. Hammond, Dean of Engineering of the Pennsylvania State College, was chairman of this committee, which was composed of 12 outstanding engineering educators. These objectives are so vital to the present-day engineering outlook and so important when we are considering Safety Engineering that they shall be here repeated.

". . . Two stems are thus implied in the undergraduate curriculum which we have designated as the scientific-technological and the humanistic-social. Each of these should be organized in an articulated sequence of subject matter and disciplines designed to lead to definite educational objectives.

"The scientific-technological studies should be directed toward:

1. Mastery of the fundamental scientific principles and a command of basic knowledge underlying the branch of engineering which the student is pursuing. This implies: (a) grasp of the meaning of physical and mathematical laws, and knowledge of how they were evolved and of the limitations in their use; (b) knowledge of materials, machines, and structures. 2. Thorough understanding of the engineering method and elementary competence in its application. This requires: (a) comprehension of the interacting elements in situations which are to be analyzed; (b) ability to think straight in the application of fundamental principles to new problems; (c) reasonable skill in making approximations, and in choosing the type of approach in the light of the accuracy required and the time available for solution—in sum, a foundation for engineering judgment; (d) resourcefulness and originality in devising means to an end; (e) understanding of the element of cost in engineering and the ability to deal with this factor just as competently as with technological factors. 3. Ability to select the significant results of an engineering study and to present them clearly and concisely by verbal and graphic means. 4. Stimulation of a continuing interest in further professional development.

The humanistic-social studies should be directed toward: 1. Understanding of the evolution of the social organization within which we live and of the influence of science and engineering on its development. 2. Ability to recognize and to make a critical analysis of a problem involving social and economic elements, to arrive at an intelligent opinion about it, and to read with discrimination and purpose toward these ends. 3. Ability to organize thoughts logically and to express them lucidly and convincingly in oral and written English. 4. Acquaintance with some of the great masterpieces of literature and an understanding of their setting in and influence upon civilization. 5. Development of moral, ethical, and social concepts essential to a satisfying personal philosophy, to a career consistent with the public welfare, and to a sound professional attitude. 6. Attainment of an interest and pleasure in these pursuits and thus of an inspiration to continued study.

"There can be no question in our minds regarding the soundness of these scientific-technological objectives. These objectives are mechanical; there is no degree of

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An address given before the Glass Division of the National Safety Council.

1. H. P. Hammond, "Report of Committee on Aims and Scope of Engineering Curricula", Journal of Engineering Education, 30 (7) 555-66 (1940)

humanness or warmth to them. A person possessed of these talents alone would be a dreary sort of individual. The objectives of the humanistic-social studies are splendid. In fact, they are almost altruistic, and the spirit of these objectives as they are here printed varies in but one respect from my conception of what these studies should accomplish. Take for example, No. 4, ". . . acquaintance with some of the great masterpieces of literature". This acquaintance develops the individual, but only indirectly does it affect the "man on the bench" in an organization. It has always been my belief that one of the greatest duties of an engineer is to protect the well-being of those with whom he associates, especially those who are in a subordinate capacity. It is a splendid thing for a person to be well educated and to have a satisfying personal philosophy, but my consideration is that he should not keep it to himself. We must contribute something; we must share with others. This does not necessarily mean financial support. The greatest thing in life, to me, is to be able to help the less fortunate to achieve happiness and to attain those same pleasures which we enjoy.

"Professional engineering is defined according to the Education Law of the State of New York[2]: "A person practices professional engineering, within the meaning an intent of this article, who holds himself out as able to perform, or who does perform any professional service, such as consultation, investigation, evaluation, planning design, or responsible supervision of construction or operation, or connection with any public or private utilities, structures, buildings, machines, equipment processes, works or projects *wherein the safeguarding of life, health or property is concerned or involved,* when such professional service requires the application of engineering principles or data."

The most significant part of this definition says, ". . . wherein the *safeguarding of life, health, or property* is *concerned* or *involved.*" I believe you will agree with me that the engineering colleges very efficiently equip their students to safeguard life and property from structural failure. Too little emphasis is placed upon safeguarding of life and health by any other means than that included in structural design. This definition and our own convictions should be sufficiently authoritative for us to justify the inclusion of safety engineering as a supplementary course in our engineering instruction.

It has been suggested by the A.S.S.E., by Georgia Tech, by Illinois Tech, and others that a one-semester, two-hour course in safety and hygiene would provide a sufficient background for an engineer. It would be my suggestion to make the course a three-hour course for one semester and to include the subjects of ethics and engineering practices.

I would like to enumerate a few thoughts on the objectives of a course in safety and industrial hygiene in the form of attributes which should be possessed by all engineering graduates:

(1) A young engineer, upon graduation, finds himself in a peculiar but interesting situation. In order to get along and to succeed, he must have the whole-hearted support of those who work under him or with whom he associates in his business pursuits. At the same time, he must appreciate the objectives of the management and conform to management's demands for sound economic practices. Some engineers fail because they lean too heavily either up or down. (2) An engineer must have the respect of the men with whom he associates. (3) An engineer should be able to receive and to delegate authority. (4) An engineer should have a degree of aloofness. (5) An engineer should have a knowledge of mechanization. He should know the answers to the question, "What economic effect will be produced when machines replace persons?"

(6) The engineer should be a "father confessor". In order to get whole-hearted cooperation, the engineer should have that degree of aloofness but, at the same time, he should be prepared to advise with some degree of authority upon such subjects as drinking, biological disorders, social diseases, wage incentives, Americanization, personal financing, and many other such topics. In other words, the engineer should have all the requisite qualifications of a good guidance officer. The guidance should be spontaneous, natural, and given with earnest interest. (7) An engineer should have an appreciation for history, so that he is aware of what has transpired in the past and so that he can again advise with authority upon subjects which come up and which are believed to be new. (8) An engineer must realize that individual aptitudes vary widely. He must be acquainted with aptitude testing and with the results which may be obtained from these tests. An adjustment of personnel to positions for which they are qualified would surely assure greater efficiency in plant operation and largely help individuals to secure happiness and contentment in their work, to which they are certainly entitled.

A good safety program is a matter of good selling. The time and effort spent upon safety in an engineering college and in continued study after graduation would be lost unless it was put to use. It can be conceived that safety programs may fail due to the personal characteristics of those promoting the project. An engineer or such person equipped with the human qualifications or attributes listed above could put a safety program across.

It therefore seems to be expedient to include and to emphasize traits of leadership, of personal guidance, and of humanness in any engineering curriculum. A person qualified in these respects would materially aid in the promotion of safety and industrial Hygiene work. In other words, it boils down to "the man".

The following presentation is a brief and condensed outline of those topics which I believe would make a well-balanced indoctrination course in safety, industrial hygiene, ethics and engineering practices.

1. The Engineering Profession. (a) Objectives of Engineering Education; (b) Objectives of Technical Societies; (c) Objectives of Engineering Institutes; (d) The Value of Membership in Societies; (e) Professional Engineering Licensure.

2. Codes of Ethics in Engineering. (a) In Engineering; (b) In the other Professions; (c) In Business; (d) In the Community; (e) In the Country.

3. Historical Fundamentals. (a) History of Civilization; (b) History of American Way of Life; (c) History of Labor Inventives; (d) History of Aptitude Testing; (e) Interpretation of Aptitudes.

(*Continued on page* 488)

2. Higher Education, Handbook 36, page 57, Education Law, Article 55, Section 6, The University of the State of New York.

RESEARCH IN APPLIED OPTICS AT THE NATIONAL BUREAU OF STANDARDS

BY IRVINE C. GARDNER, CHIEF

Optical Instruments Section, National Bureau of Standards

A broad program[1] of optical research and development, basic to the production of all types of optical instruments, has been carried on at the National Bureau of Standards since its founding in 1901. This work has resulted in the establishment of procedures for measuring and specifying the characteristics of photographic lenses, the development of military optical fire-control devices and methods for testing them, the construction of very large optical elements for supersonic wind tunnels and astronomical work, and the development of methods of high-precision refractometry and standards of refractivity for use in the food, paint, drug, and other industries.

Optical instruments include not only those instruments developed for making measurements within the field of optics but also numerous devices which serve as tools in other scientific work and in commercial and industrial applications. Within the first group, many of which have found important commercial uses, are spectrometers, polarimeters, interferometers, refractometers, and diffraction gratings. In the second and much larger group are astronomical telescopes, microscopes, binoculars, surveying instruments, motion picture projectors, and airplane camera lenses. An outstanding characteristic of all optical instruments is the high precision necessary in their operation. This requires extremely accurate design and construction of all optical and mechanical parts.

In both world wars, the requirements of the Armed Forces for optical fire-control instruments resulted in a tremendous increase in domestic production of optical glass and optical instruments. Indeed, the peacetime requirements for precision optical instruments are almost negligible in comparison with the need for military optical instruments in wartime. The American optical industry was thus obliged to expand enormously during the two wars. Similarly, the demands made on the National Bureau of Standards increased greatly, and many new instruments and new optical glasses were developed at the Bureau.

In view of this apparent need for rapid expansion of the optical industry in wartime, the National Bureau of Standards, with the cooperation of the armed services, has conducted since World War I a continuing, integrated program of research and development in the optical sciences. The Bureau is able to render such service because it is the only scientific institution in the world which has, entirely within its own organization, complete facilities for making an optical instrument beginning with the raw materials and producing in turn the glass, the optical design, the lenses and prisms, the mechanical

Fig. 1. A new precision camera calibrator recently developed by the Bureau is tested for accuracy in its optical instruments laboratory. The test involves determination of the angular deviation between collimators in the collimator bank beneath the table. Light from any two adjacent collimators is reflected by a biprism mounted above the hole in the circular plate in such a way as to produce an image in the eyepiece of the telescope when the proper angular difference exists between the two collimators. The adjustment necessary to bring the image into the field of view in the telescope, as read on the micrometer below the eyepiece, indicates the amount by which the angular position of the collimators must be corrected.

Fig. 2. The two standard planes of fused quartz within the bell jar were constructed to be accurately plane within approximately one-millionth of an inch. They are being tested for accuracy. Monochromatic light produced by a helium arc in the small black box beneath the eyepiece travels down through the vertical tube and is reflected upward to the quartz planes by mirrors beneath the table. Here it undergoes partial reflection by the two flat surfaces being compared, and the various reflected wave trains return to the eyepiece along a path similar to that taken by the incident rays. Interference fringes at the eyepiece result from the difference in the distances traversed by wave trains reflected from the two faces of the quartz. Any departure from planeness is determined from a corresponding lack of straightness in the fringes.

parts, and finally the finished instrument. A certain portion of this program is necessarily restricted to military applications, but the greater part of the results are of broad interest in such fields as photography, television, astronomy, sugar chemistry, aerial mapping, surveying, and aerodynamics.

Photographic Lenses

The Bureau's work on photographic lenses has played an important part in placing photography—once largely an empirical art—on a more exact, quantitative basis. Although the Bureau has conducted research on the theory and methods of lens design for almost 50 years, the work on photographic lenses really began at the close of World War I, when the Army Air Corps submitted several captured German airplane camera lenses for investigation. Soon after, the Government mapping services and the military agencies became interested in photogrammetric methods, by means of which both cadastral and topographic maps can be made from airplane photographs. As the science of photogrammetry, with its exacting requirements for aerial camera lenses, advanced from this early beginning, the Bureau constantly improved methods for measuring the characteristics of these lenses.

To be suitable for photogrammetric use, an airplane camera lens must have good resolving power and little or no distortion over the entire field. The Bureau therefore undertook the development of methods for measuring and specifying these characteristics. The measurement of distortion in a lens as the linear displacement of the image point from its distortion-free position—a value convenient for direct interpretation—was substituted for the older percentage method of designating distortion. The Bureau also introduced the practice of measuring the resolving power of photographic lenses by a photographic method exclusively and began expressing the result in terms of lines per millimeter measured on the negative. Finally, the calibrated focal length was defined and recommended, instead of the equivalent focal length, for use with airplane cameras for map making. All of these practices have now come into general use in the United States and have been widely accepted in many other countries.

The earlier measurements of distortion were made on an optical bench, but this method became inadequate as the volume of work rapidly increased. Furthermore, laboratory tests indicated that the performance of a photographic lens must be studied by a photographic test in order to correlate results with performance in actual use. To meet this need, the precision testing camera was developed and constructed. Two negatives made on this instrument, each containing a series of 19 exposures, enable distortion, resolving power, astigmatism, and curvature of field to be assessed at five-degree intervals across one diameter of the field of view. At first this testing camera was equipped with seven collimators, permitting a 60-degree field to be investigated. Later, as wide-angle lenses came into general use, three additional collimators were added so that a 90-degree field could be accommodated. More recently the Bureau has developed a new precision camera calibrator[2] which has a

Fig. 3. Grinding a telescope lens in the optical shop. The grinding tool, a cast-iron disk having a surface of the desired curvature, is mounted on a slowly rotating vertical spindle and covered with an abrasive. The surface of the glass blank to be ground is pressed down against the tool by means of a pin with ball end which fits into a depression in the center of a metal "button" waxed onto the blank. As the glass disk rotates about the pin because of its contact with the rotating tool, the operator, by means of the long lever pivoted at the right, pushes the spinning disk back and forth across the tool. This combination of rotation and translation produces uniform abrasion over all parts of the lens surface.

Fig. 4. A telescope objective must be polished so precisely that the finished surface does not depart from regularity by more than six millionths of an inch. This is done by means of a rotating pitch surface pressed into the proper curvature and charged with rouge and water. The lens, cemented to a small metal disk, is pressed down against the pitch-covered tool by a pin that fits in a depression in the center of the metal disk. Lateral motion of the pin support swings the lens back and forth across the tool as it rotates. Rouge and water are applied with a brush between the two surfaces at intervals. Note that the surface of the pitch is marked off into squares by grooves which receive excess polishing materials.

number of advantages over the previous instruments. For example, it requires but one negative to study the entire field of a camera lens whereas the older method required four. It is also much more compact and incorporates a number of unusual design features.

In recent years, the requirements of the Agricultural Adjustment Administration and of the Soil Conservation Service for prompt delivery of maps of large areas have greatly stimulated the establishment of engineering firms specializing in airplane photography and map preparation. This has resulted in a need for standard specifications to be used by Government procurement offices in contracts with airplane-mapping agencies. Such standard specifications are now prepared under the guidance of the Photogrammetric Society of America. They require that bids for Government contracts be accompanied by a National Bureau of Standards certificate applying to the lens and camera which the contractor proposes to use. During 1949, 447 cameras and photographic lenses for photogrammetric work were tested or certified at the Bureau.

With the development of precise quantitative relations in most phases of photographic work, a demand has arisen for the extension of similar precision to the speed marking of lenses. The method now in general use is based entirely upon the ratio of the equivalent focal length of the lens to the diameter of the aperture. This ratio, known as the *f*-number, gives no consideration to the great differences in the useful light transmitted by various lenses. These differences are the result of absorption in the glasses of which the lens elements are made or reflection and scattering at the surfaces. The introduction of reflection-reducing coatings has accentuated the variation in performance to such an extent that for a given *f*-number the light transmitted by two lenses may differ almost by a factor of two.

As a result of this situation, the method of marking the diaphragms in terms of "*t*-stops" has come into favor, and the Bureau, at the request of the Society of Motion Picture Engineers, has developed an improved method[3] for calibrating the diaphragm openings of a photographic lens in terms of this system of marking. This method, in contrast to the system that has been in use, takes into account the losses of light within the lens. It thus permits a more precise and accurate control of the amount of light admitted to a photographic film during an exposure, with a corresponding increase in the uniformity and quality of results. Such a system of marking is particularly important in color photography because of the smaller latitude of exposure of color film. However, it appears likely that the new system will eventually be extended to all photographic lenses.

Studies at the Bureau have also led to a more scientific and valid analysis[4] of the causes of uneven negative exposure. It is well known that the effective exposure through a photographic lens is a maximum at the center

Fig. 5. Centering and edging lens components in the Bureau's optical shop. It is customary to make a lens oversize in order that the edge may be finished after the surfaces have been polished. This operation also centers the edge with respect to the axis of the lens. After the lens is correctly centered on the rotating spindle in the left foreground, the two spindles will be interchanged so that the edge of this lens may be ground true on the large diamond-charged wheel at the operator's right. Meanwhile, the lens attached to the second spindle, which has already been centered, is undergoing the edging operation. Accuracy of centering is tested by observation of images reflected from the two surfaces of the lens.

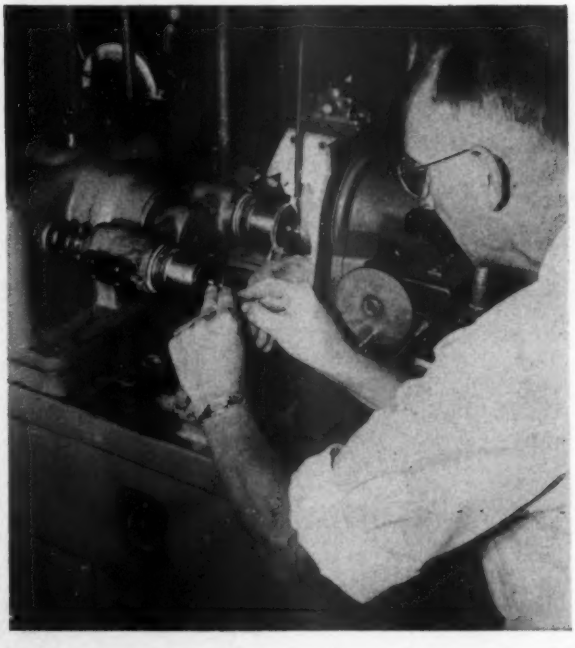


Fig. 6. Application of a low-reflecting coating of magnesium fluoride to the lens components of a telescope objective reduces light losses by reflection from about 5 percent to less than 1 percent. This process is carried out by heating the magnesium fluoride in a vacuum with the lens components so that it is vaporized and condenses on their exposed surfaces. The small porcelain crucible at the center of the circular plate (lower left) contains magnesium fluoride and an electric heating coil. After the lens components are properly placed on the rack above the crucible, a bell jar is lowered, as at right, to make an air-tight connection with the circular base plate. By means of oil diffusion pumps, the air is removed until the pressure is less than one-thousandth of a millimeter of mercury, and the magnesium fluoride is then volatilized. The process is stopped when a thickness of four millionths of an inch (one-fourth the wavelength of light), as determined from the color of the deposit, is formed.

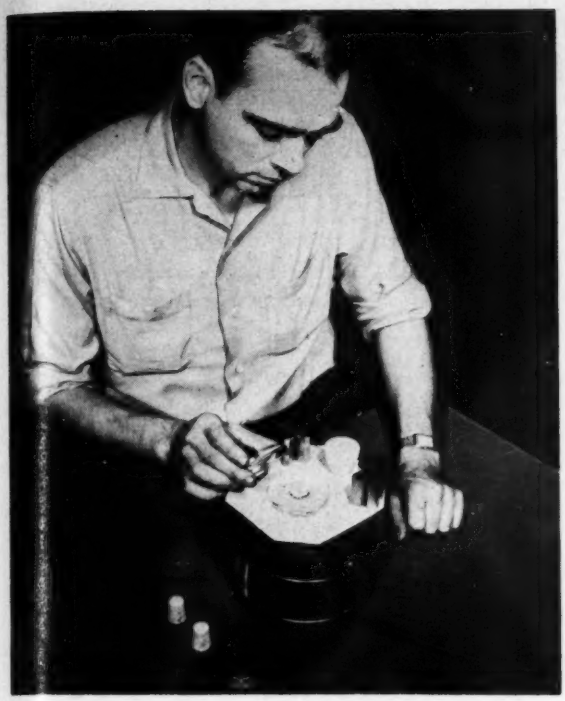
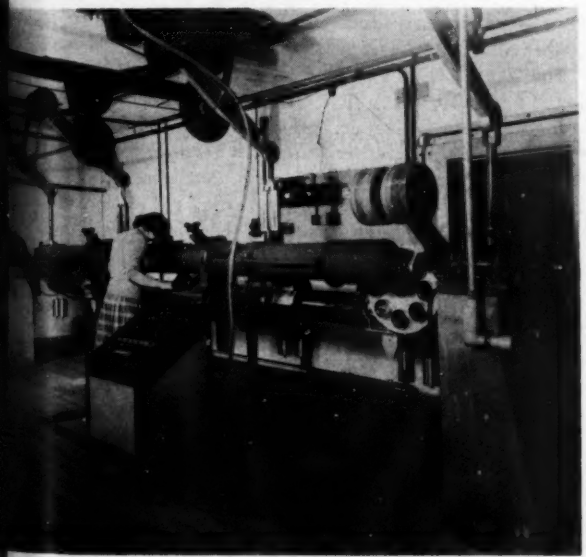


Fig. 7. Lens components of two different kinds of glass are cemented together to form an "achromatic" telescope lens which will focus light of all colors at the same point. A drop of Canada Balsam cement has just been applied to the concave surface of a flint-glass component lying on the hot plate. After heating to drive off the more volatile constituents of the balsam, a crown-glass component is pressed against the flint until only a thin layer of balsam remains between the surfaces. The balsam hardens on cooling, and the two glasses are firmly united to form a telescope objective.

Fig. 8. The range finder testing laboratory at the National Bureau of Standards is the only one in this country and is believed to be the most complete in the world. The testing apparatus is arranged to provide for eight distinct simulated targets (note turret with eight apertures, right) at distances from infinity to 500 yards and for settings in elevation at 5-degree intervals from 0° (right) to 90° (left). Temperature of the test room may be maintained at any desired value between 0°F and 110°F.



of the negative and decreases rapidly toward the edge. Various techniques have been used in attempts to reduce this variation in image illumination, but all methods have required special photographic manipulation. The Bureau's investigation explains the discrepancies that other workers have encountered in studying the variation of relative illumination from center to edge of the focal plane, and should aid materially in the design of photographic lens systems where even exposure is important. In particular, it puts the development of extremely wide angle lenses on a sounder basis and points the way toward substantial savings in airplane mapping.

Refractometry

Another field in which the Bureau has pioneered is refractometry, the measurement of the index of refraction of optical materials. At the close of World War I instruments for measuring refractive index began to be produced in this country in response to the need for precise data on the optical glass manufactured during and immediately after the war. Use of these instruments increased rapidly in chemical laboratories and spread to technical applications in the sugar, oil, soap, drug, paint, ink, food, and other industries. The Bureau was then called upon to test refractometers, to formulate standard requirements for these devices, and to measure refractive indices of transparent media.

To perform these services to industry and other Government departments, the Bureau found it necessary to develop methods of high-precision refractometry in order to establish working standards of known refractivity. Use of water as a precise standard liquid in this work was made possible by accurate measurement of its index of refraction over a broad range of temperature and wavelengths.

In recent years infrared spectrometry has found extensive application as a tool for analysis of mixtures of organic compounds and as a means of correlating the properties of substances such as cellulose with the structure of their molecules. A knowledge of the optical properties of materials which transmit infrared radiation has thus become important. Synthetic crystals of thallium halides and of silver chloride are now available for work in this part of the spectrum, and the Bureau has extended its measurements of index of refraction to include the infrared region.[5] Values have been obtained for thallium bromide-iodide, silver chloride, and optical glass. A parallel investigation is being made of that portion of the ultraviolet spectrum which is transmitted by optical glass.

Interferometry

Precise measurements of the homogeneity—that is, the uniformity of index of refraction—of single components of optical glass are made with the interferometer. Such determinations are particularly important because variations in index of refraction establish limits for the performance of an optical system manufactured by production methods without retouching of surfaces. The Bureau has constructed and put into operation a large interferometer of 4-inch aperture, and another, of 10-inch aperture, is nearing completion. With these instruments large photographic lenses of 40- to 50-inch focal length

(*Continued on page* 486)

INVENTIONS AND INVENTORS

A Summary of Recently Issued Patents of Interest to the Glass Industry

Feeding and Forming

Blowing Machine. Fig. 1. Patent No. 2,515,372. (Four sheets of drawings.) John R. Johnson and Richard D. Duff assigned this invention to Owens-Illinois Glass Company. The machine has incorporated a device for blowing an acidic gas, such as sulfur dioxide, into the ware immediately after it is blown, for the purpose of neutralizing alkalinity.

The invention is shown as applied to the well-known Owens machine having blow molds 13 for making three bottles 20. Gas nozzles 21 are mounted on an arm 28. Power is supplied by a shaft 41 for rotating the nozzles so that they are in position to discharge gas into the bottles and then move out of the way of other parts. The rotation of the nozzles also turns the gas supply off and on.

The following references are of record in the file of this patent: United States Patents: 981,768, Ketterer, Jan. 17, 1911; 1,066,285, Ketterer, July 1, 1913; 2,154,490, Burch, Apr. 18, 1939; and 2,402,387, Ferguson, June 18, 1946.

Glass Mixing Feeder. Fig. 2. Patent No. 2,515,478. (One sheet of drawings.) Messrs. Tooley, Russell, and Wiley assigned this invention to Owens-Corning Fiberglas Corporation. The invention is particularly adapted for use in the manufacture of glass fibers, but it may well be used wherever it is desired to reduce the cords in the glass and to increase the homogeneity.

The figure shows a forehearth 10 connected with the glass in the tank through a screen 13. The mixing device comprises inner and outer shells 14 and 15 made of platinum and arranged to form an annular passage connected at its lower end with an orifice 36. The molten glass flows into the cylinder 14 through a series of passages 19 where it is mixed and lifted by a stirrer 21 having a screw-like projection on its lower end. The glass then flows through a fine screen 38 to the orifice 36 from which it is discharged with little or no cords.

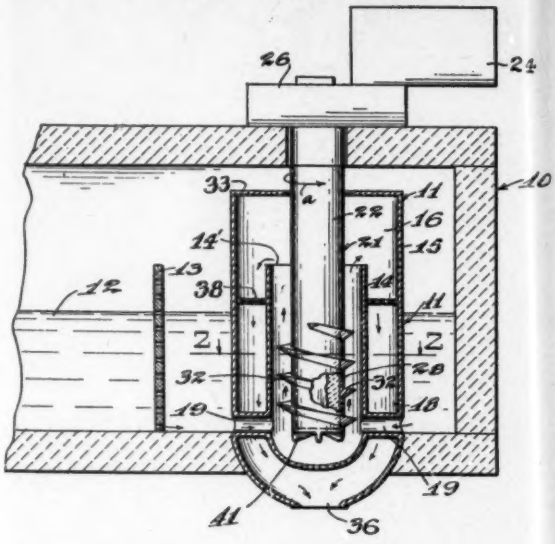


Fig. 2. Glass Mixing Feeder.

The following references are of record in the file of this patent: United States Patents: 1,778,775, Soubier, Oct. 21, 1930; 2,055,676, Stewart, Sept. 29, 1936; and 2,133,236, Slayter et al., Oct. 11, 1938. Foreign Patents: 711,976, France, July 8, 1931.

Glass Mixing Feeder. Fig. 3. Patent No. 2,515,481. (Three sheets of drawings.) Ronald B. Wiley and Robert G. Russell assigned this invention to Owens-Corning Fiberglas Corporation. The object of the invention is to get rid of the cords usually found in molten glass. This is particularly necessary when the glass is to be used for fibers of small diameter.

The figure shows the boot 10 having an orifice 12 in the bottom through which the molten glass flows. In order to reach the orifice, the glass has to pass through a platinum screen 13, around which revolve stirrers 18. The flow of glass from the orifice is controlled by a vertically adjustable plug 30. Any cords in the glass are arranged parallel to the screen by the stirrers and then broken into short pieces by passing through the screen. There are ten references cited by the Patent Office.

Glass Shears. Fig. 4. Patent No. 2,518,871. (Three sheets of drawings.) Assigned to General Electric Company by Charles W. Craig. These shears will cut gobs from a rapidly flowing stream of glass with great uniformity and for long periods of time.

The invention comprises a pair of shear arms 4 and 5 having proper blades and the usual adjustments. The arms are water-cooled. The shears are opened and closed by links 34 connected at one end to a slide 40. The slide is reciprocated by a link 56 actuated by a crank 54. Air

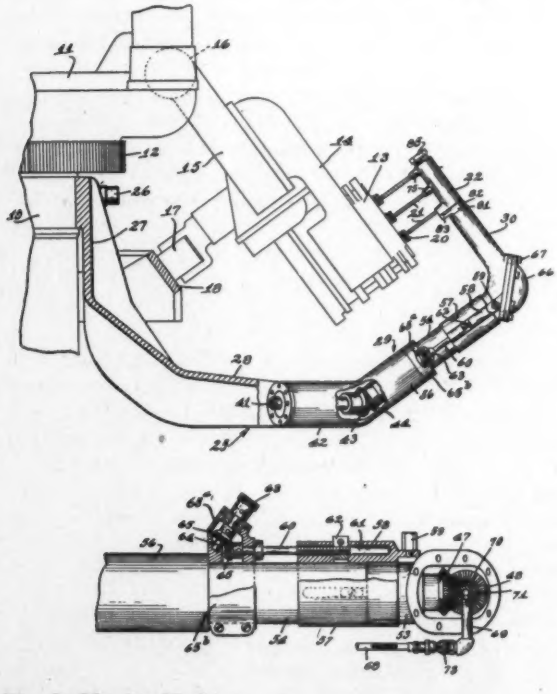


Fig. 1. Blowing Machine.

cylinders 61 and 64 throw the crank alternately in opposite directions thus reciprocating the slide 40 and causing the shears to close and open again. A timing valve is provided to start the cycle of operation at the proper time.

The two references cited by the Patent Office were 1,806,743, Cramer, May 26, 1931 and 2,218,970, Honiss, Oct. 22, 1940.

Furnaces

Temperature Control for Electric Melting. Fig. 5. Patent No. 2,516,570. (Two sheets of drawings.) Assigned to Westinghouse Electric Corporation by Edward C. Hartwig and James L. Reed.

The invention is set forth in Claim 1 as the method of controlling the temperature of molten glass which comprises deriving pulses of electric current from a commercial alternating current source, said pulses having a duration of less than a period of said source; heating the glass by continuous passage of said pulses of electric current therethrough; deriving a control potential which is proportional to the magnitude of said pulses; and continuously changing the time duration of each of said pulses in accordance with the magnitude of said control potential.

The figure shows a modified form of the invention in a diagrammatic way. The tank 5 has five pairs of electrodes 9 and 11, the current to each pair being regulated by a control circuit 138 which is shown in detail in another figure of the patent. The control circuit provides means by which the heating effect between each pair of electrodes may be varied as desired.

The patent contains five claims and 18 references were cited by the Patent Office.

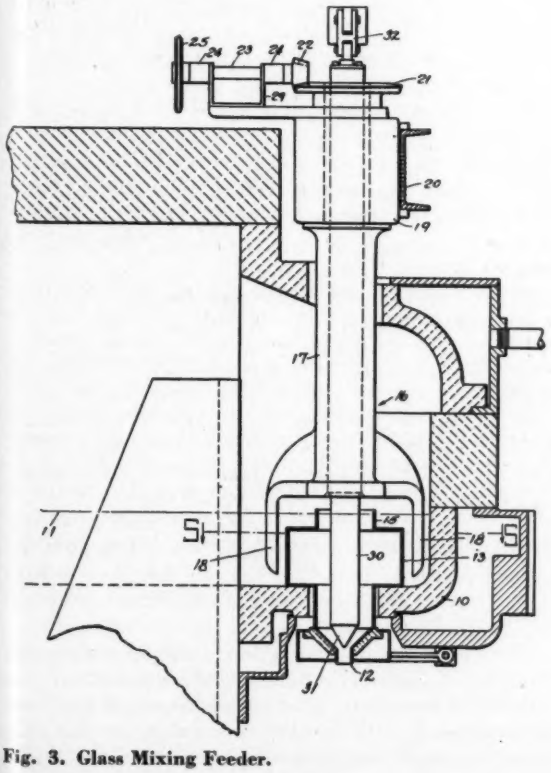


Fig. 3. Glass Mixing Feeder.

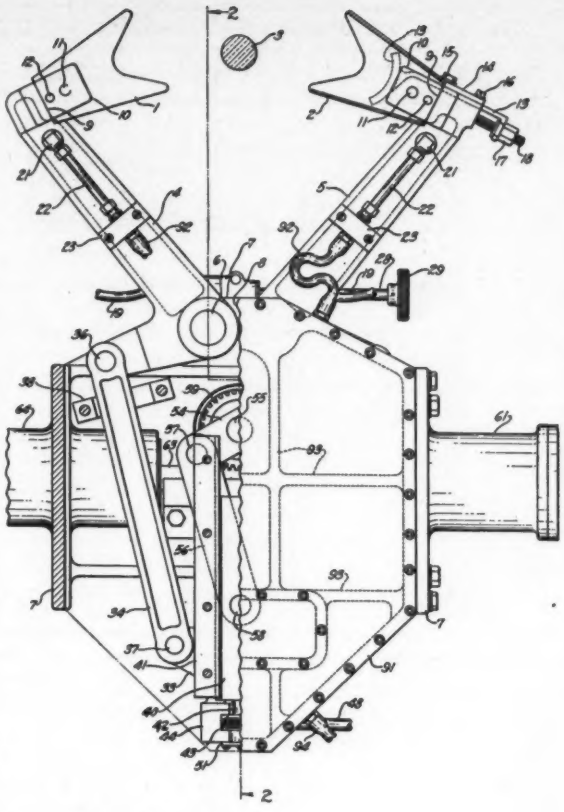


Fig. 4. Glass Shears.

Glass Compositions

Electric Insulating Glass. Patent No. 2,513,958. (One sheet of drawings, none reproduced here.) Herbert A. Omley assigned this invention to General Electric Company. This glass is designed particularly for use in insulating bushings where the glass must have good insulating qualities and also be well adapted for sealing to metal parts.

The drawings show two forms of electric bushings and a graph comparing the expansion of the glass at different temperatures with the expansion of a metal to which it may be sealed. The electrical characteristics of this glass are given as:

Resistivity	6.0×10^{14} ohms/—3 cm.
Dielectric constant	7.15
Power factor	0.15

Claim 1 of the patent sets forth the invention as a glass suitable for casting purposes comprising by weight 56 to 62 per cent SiO_2, 19.5 to 24 per cent B_2O_3, 2 to 3 per cent Li_2O, 4.5 to 7 per cent Na_2O, 1 to 4 per cent K_2O, 3 to 8 per cent Al_2O_3, 0.1 to 1 per cent CaO and 3 to 7 per cent PbO.

No references were cited by the Patent Office.

Corning Optical Glass. Patent No. 2,517,459. (One sheet of drawings, none reproduced here.) William H. Armistead assigned this invention to Corning Glass Works. This patent has a relation to Patent No. 2,435,-995 granted to the same inventor.

The following compositions in per cent by weight as

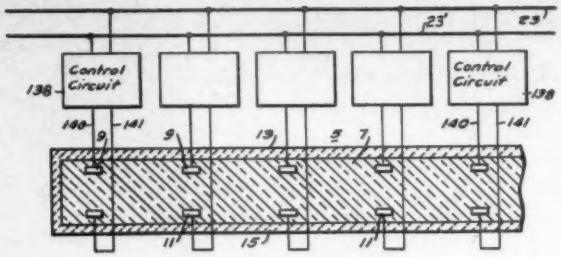


Fig. 5. Temperature Control for Electric Melting.

calculated from their batches illustrate the glasses of this invention:

	A	B	C	D	E	F	G	H
SiO_2	20	20	20	5	15	15	15	13.6
B_2O_3	20	20	20	30	15	15	15	13.6
BeO	10	5	5	7.5	5	5	5	4.6
CaO	50	55	50	15	25	25	20	22.7
SrO	—	—	—	15	—	—	—	—
ZrO_2	—	—	5	7.5	—	5	5	—
BaO	—	—	—	20	40	35	30	36.4
PbO	—	—	—	—	—	—	10	9.1
*n*D	1.6453	1.6471	1.6559	1.6572	1.6635	1.6766	1.6924	1.6927
v	56.3	55.1	54.0	54.6	53.5	51.9	46.4	46.0

	J	K	L	M	N
SiO_2	15	15	13.5	12.5	15
B_2O_3	15	15	13.5	15	15
BeO	5	5	4	5	5
CaO	20	20	20	20	20
ZrO_2	4	5	4	5	5
BaO	16	15	30	15	—
PbO	—	5	15	—	—
CdO	25	20	—	27.5	40
*n*D	1.7000	1.7071	1.7093	1.7138	1.7169
v	48.0	45.4	42.8	46.0	45.3

The following references are of record in the file of this patent: United States Patents: 576,896, Rudolph, Feb. 9, 1897; 2,321,973, Bennett, June 15, 1943; and 2,406,580, Bostick et al., Aug. 27, 1946. Foreign Patents: 388,118, Great Britain, 1933. Other References: Ordnance Dept. Document No. 2037, May 1921—table 4, pp. 59, 60, 61, 62.

Optical Glass. Patent No. 2,518,028. (No drawings.) Assigned to Bausch & Lomb Optical Company by Norbert J. Kreidl.

The invention is characterized by including two to ten per cent of tantalum or columbium. This results in a chemically stable glass which can be readily coated. In the following table, examples 1, 2, and 3 are compositions coming under this patent while example 4 is a standard composition given for the purpose of comparison.

Examples	1	2	3	4
SiO_2	30.0	26.6	30.0	26.6
B_2O_3	30.0	28.9	28.9	25.4
Al_2O_3	1.7	1.8	1.8	1.8
BaO	27.0	30.0	26.6	37.0
ZrO_2	1.9	1.9	1.9	1.9
La_2O_3	7.2	7.2	7.2	7.2
Ta_2O_5	2.2	3.5	..	..
Cb_2O_3	..	..	3.5	..
n_D	1.7	1.73	1.7	1.695

The only reference cited by the Patent Office was Patent No. 2,434,149 to DePaolis, dated Jan. 6, 1948.

Corning Photosensitive Glasses. Nine patents were issued to Corning Glass Works on July 18, 1950, all relating to photosensitive glasses. These glasses, when treated to ultraviolet or other short wave radiations, are affected so that upon reheating photographic images appear. In some cases these images may be colored. Each patent gives details for the manufacture and use of the glass. The following list gives one claim from each patent, together with the name of the inventor. For complete information, all the patents should be studied and compared. Some of the patents include drawings, none of which have been reproduced here.

Patent No. 2,515,275, Stanley D. Stookey inventor, (No drawings). Claim 1: A photosensitive glass consisting essentially of a silicate glass containing on the oxide basis by weight the indicated proportion of a photosensitizing constituent selected from the group consisting of 0.01% to 0.1% gold computed as Au, 0.05% to 0.3% silver computed as AgCl, and 0.05% to 1% copper computed as Cu_2O, up to 0.05% CeO_2, and up to 0.1% Sb_2O_3. References cited: 2,049,765, Fischer, Aug. 4, 1936 and 2,422,472, Dalton, June 17, 1947.

Patent No. 2,515,936, William H. Armistead inventor, (No drawings). Claim 5: An article comprising a body of irradiated, substantially colorless photosensitive glass consisting essentially of a silicate glass containing, on the oxide basis by weight, 0.05% to 0.3% of silver computed as AgCl, said glass body containing within its mass a predetermined latent photographic image capable of being developed, by uniform heating of the entire glass body, into a visible, colored image exhibiting photographic detail. 18 references cited.

Patent No. 2,515,937, Inventor S. D. Stookey, (One sheet of drawings). Claim 13: The method of making a glass article which comprises forming an article of a substantially colorless photosensitive glass consisting essentially of an oxidized silicate glass containing on the oxide basis by weight about 0.01% to about 0.03% of gold computed as Au, exposing selected areas of the article to short-wave radiations, heating the article uniformly for a time and at a temperature sufficient to develop color in the exposed areas, thereafter exposing hitherto unexposed areas to short-wave radiations and thereafter again heating the article uniformly for a time and at a temperature sufficient to develop color in the subsequently exposed areas. 20 references cited.

Patent No. 2,515,938, S. D. Stookey inventor, (No drawings). Claim 3: An article comprising a body of irradiated, substantially colorless photosensitive glass consisting essentially of a reduced silicate glass containing on the oxide basis by weight 0.05% to 1% of copper computed as Cu_2O and CeO_2 in an amount up to 0.05%, said body containing within its mass a predetermined latent photographic image capable of being developed, by uniform heating of the entire glass body, into a visible, colored image exhibiting photographic detail. 18 references cited.

Patent No. 2,515,939, S. D. Stookey inventor, (No drawings). Claim 1: A transparent photosensitive glass consisting essentially of a thermally opacifiable, fluorine-containing silicate glass containing, on the oxide basis by weight, the indicated proportion of a photosen-

sitive metal selected from the group consisting of 0.01% to 0.03% of gold computed as Au, 0.05% to 0.3% of silver computed as AgCl, and 0.1% to 1% of copper computed as Cu_2O, and CeO_2 in an amount up to 0.05%. 23 references cited.

Patent No. 2,515,940, Inventor S. D. Stookey, (One sheet of drawings). This patent contains 21 claims. Claim 21 is as follows: The method of making a glass article which comprises forming an article of a photosensitive glass consisting essentially of a silicate glass containing, on the oxide basis by weight, 10% to 25% Li_2O and the indicated proportion of a photosensitive metal selected from the group consisting of 0.004% to 0.05% of gold computed as Au, 0.025% to 0.3% of silver computed as AgCl, and 0.04% to 1% of copper computed as Cu_2O, exposing an area of the article to short-wave radiations and thereafter heating the article uniformly for a time and at a temperature sufficient to cause precipitation of lithium disilicate crystallites in the exposed area. The following references are of record in the file of this patent: United States Patents: 2,049,765, Fischer, Aug. 4, 1936; 2,144,943, Sharp et al., Jan. 24, 1939; 2,237,042, Truby, Apr. 1, 1941; 2,326,012, Dalton, Aug. 3, 1943; and 2,422,472, Dalton, June 17, 1947.

Patent No. 2,515,941, Inventor S. D. Stookey, (One sheet of drawings). Claim 13 is a method claim. The method of making a glass article which comprises forming an article of a photosensitive glass consisting essentially of a silicate glass containing, on the oxide basis by weight, 50% to 65% SiO_2, 5% to 15% of an alkali metal oxide selected from the group consisting of Na_2O, K_2O, and mixtures of Na_2O and K_2O, 15% to 45% BaO, and 0.004% to 0.05% of gold computed as Au, exposing an area of the article to short-wave radiations, and thereafter heating the article uniformly for a time and at a temperature sufficient to cause precipitation of barium disilicate crystallites in the exposed area. The following references are of record in the file of this patent: United States Patents: 2,049,765, Fischer, Aug. 4, 1936; 2,144,943, Sharp et al., Jan. 24, 1939; 2,237,042, Truby, Apr. 1, 1941; 2,292,684, Blau, Aug. 11, 1942; 2,326,012, Dalton, Aug. 3, 1943; and 2,422,472, Dalton, June 17, 1947.

Patent No. 2,515,942, Inventor S. D. Stookey, No drawings. Claim 15: The method of imparting a brownish hue to the colors produced in a photosensitive glass consisting essentially of an oxidized silicate glass containing, on the oxide basis by weight, the indicated proportion of a photosensitizing agent selected from the group consisting of up to 0.1% gold computed as Au and up to 0.03% silver computed as AgCl, which includes the step of incorporating up to 0.02% palladium computed as Pd in the glass. No references were cited by the Patent Office.

Patent No. 2,515,943, Inventor S. D. Stookey, (One sheet of drawings). Claim 1: A clear, transparent photosensitive glass comprising essentially 55% to 75% of SiO_2, 12% to 18% of an alkali metal oxide selected from the group consisting of Na_2O, mixtures of Na_2O and K_2O and mixtures of Na_2O and Li_2O, 2% to 12% Al_2O_3, at least 0.001% but less than 0.01% of gold computed as Au, 0.005% to 0.05% CeO_2, and 1.8% to 2.4% of analytically determined fluorine, the glass being capable of heat-developed opacification only when and where it is irradiated with short-wave radiations. The references cited by the Patent Office were 2,049,765 to Fischer dated Aug. 4, 1936 and 2,326,012 to Dalton dated Aug. 3, 1943.

Glass Wool and Fiber

Fiber Making Machine. Fig. 6. Patent No. 2,515,738. (One sheet of drawings.) Assigned to Owens-Corning Fiberglas Corporation by Games Slayter and Ed Fletcher.

In the figure, a feeder is shown at 10 having a platinum bushing 13 which is electrically heated and provided with a row of orifices 14 in the bottom. Within the refractory part of the feeder, there is a high velocity burner 16 which directs a flame against the issuing glass to attenuate it into very fine filaments. The path of the filaments is controlled by a curved shield 17 which is cooled by a water system 17a. A low pressure blower 18 may be used if desired. The blast from the burner is at the rate of from 500 to 700 feet per second which produces very fine fibers at a very low cost. There are nine references cited by the Patent Office.

Miscellaneous Processes

Manufacture of Cellular Glass. Patent No. 2,514,324. (No drawings.) Assigned to Pittsburgh Corning Corporation by Walter D. Ford. The glass made by this method is adapted for use as floats for life rafts or fish nets and for thermal insulation.

The glass used to carry out this process may be of any conventional type and a list is given of the results obtained by the use of numerous sulfates in different amounts. The invention according to Claim 1 of the patent is: A process of forming cellular glass of uniform structure, having closed cells, which comprises admixing glass, pulverized to pass a screen of 200 mesh, with ap-

(*Continued on page* 484)

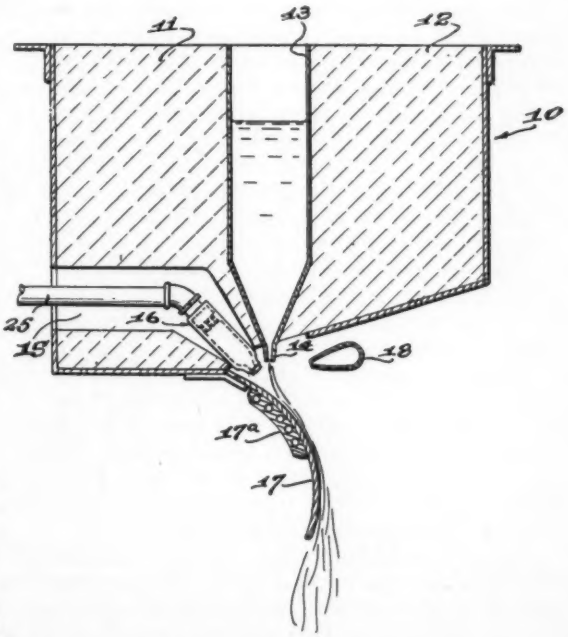


Fig. 6. Fiber Making Machine.

Research Digest

The Identification of Stones in Glass

Many papers have been written on the subject of the crystallographic properties of materials which may be found in "stones". This paper by Taylor and Hill *(Journal of the Society of Glass Technology,* February 1950), however, departs from this practice and describes the methods which are used in the Department of Glass Technology at Sheffield to identify the stones and, when possible, determine their origin.

The authors believe that when all the evidence regarding any particular stone has been correlated, the nature of the material constituting it can, in at least 95 per cent of the cases, be determined with reasonable accuracy. The remaining cases relate to rare materials regarding which there is no published information. From the evidence of the tests, it is usually possible to say something about the probable origin of the stones. Further evidence might enable one to decide what conditions had existed in order to promote the development of the stones found. Quite possibly there might be more than one cause of the particular forms in which the stones appear, in which case evidence affecting the relative probabilities of these causes must be sought.

The first step taken is to look at the stones in relation to the surrounding glass. In the case of large stones, the naked eye may be all that is required to discover, say, that the stones have the pure white, granular appearance which might indicate a "sand" stone. More profitably, however, the stones can be examined first under a X10 diameter hand lens. The features of stones which may, from such examination, provide clues at this stage may be enumerated as follows: (1) The presence or absence of a definite "sac" or cell of glass surrounding the stone. Partly dissolved aluminous stones in a soda-lime-silica glass are surrounded by a region of glass of higher refractive index than the main body of the glass and, consequently, this area shows as a well defined, fairly large sac. Siliceous stones are also often surrounded by a sac of glass with a refractive index lower than that of the bulk, but as the silica-rich glass diffuses fairly readily, the sac tends to be smaller and less well defined than one associated with an aluminous stone. Incompletely digested feldspar can also give rise to sacs, but in this case, the difference in refractive index between feldspar glass and the main glass is smaller than is the case with silica stones and the sacs are, therefore, less well defined.

(2) During the conversion of the glass into articles, the sacs are often drawn out into tails, the characteristics of which may often provide a clue. It is a general tendency for aluminous stones to be associated with long, fine, well-defined tails, which do not easily merge with the main glass. Siliceous tails, on the other hand, tend to be shorter and to merge more readily.

The evidence from sacs and tails is by no means conclusive. Their appearance depends upon the solubility rate of the stone material in the glass, at the temperature to which it has been subjected, and on the time during which the stones have been exposed to the glass.

(3) Another feature of stones, which is often of considerable help, is their color. A clear white stone frequently consists of either silica (either from batch or devitrified glass), or other devitrification products. The class of refractory from which a stone is derived may possibly be indicated by its color. It has been observed that the low-alumina refractories (pot clay and fire clay) tend to give stones with a brownish or greenish hue; sillimanite refractories tend to give pink or mauve colors; and Corhart type electrofused refractories often give stones of a greyish-blue or dull purple color. The intensity of the colors is weakened by glass attack and by solution, which promote the development of a white coating, but the color clue is often very useful. The presence of spots of iron-brown color in a stone may, again, indicate a refractory origin.

The variety of stones known as "droppers" or "drops" is often characterized by pronounced color. An aluminous refractory drop is usually strongly brown or almost black, whereas drops from silica crowns usually show as knots of a greenish colored glass.

(4) A further clue which has been of service at times in identifying stones is afforded by the presence, around the stone, of small gas bubbles. Stones from electrofused and sillimanite refractories very seldom show this effect, whereas it is a quite normal feature when "clay" stones are examined. It should be noted, however, that relatively coarse bubbles may be associated with aggregates of undissolved batch.

(5) Another characteristic which may be noted at this stage is the "build-up" of the stones, i.e., whether uniform in surface texture, or with cracks around or across, or, again, granular in appearance, and so on. A typical example of the use of this feature is in identifying sulphate "seats", where the general outline is clear, often torpedo-shaped, with a patchwork circular build-up within this outline. If large stones from tank furnaces are suspected of being refractory in origin, the particular type of block may sometimes be discovered. By grinding a flat face on the stone, it is possible to get an idea of grog size and grog distribution, which can then be compared with those of the various blocks in service.

Frequently the stones are very small or are in awkwardly shaped pieces of glass, rendering it impossible to make a satisfactory examination with a lens. In such a case, the visual examination described is necessarily omitted and the next stage, used on all stones, is applied. The procedure is simply to immerse the specimen in a liquid of as nearly as possible the same refractive index as the main body of the glass, and examine it under the microscope at a relatively low magnification, say, X40 to X60. The stone is scrutinized for the features mentioned under visual tests.

The appearance of a fringe around the stone is usually significant. A rather tenuous filmy fringe with irregular markings, appearing quite strongly bi-refringent between crossed nicols, is likely to be nepheline or, in a potash glass, lencite. Grains of quartz may often be surrounded by a fringe of tridymite, more obviously crystalline than

the nepheline fringes. Fringes of this kind are not normally associated with devitrification stones. It is also possible to examine more fully under the microscope the cords which may be associated with any stones. The strain along the cords, tensile or compressive, can be assessed and in certain cases, e.g., in a borosilicate glass where aluminous cords may be in tension, it is possible to distinguish between siliceous and aluminous cords.

For very dense stones, and for stones about which it has only been possible to obtain limited information, which is generally the case, a more complete picture can be obtained by preparing a thin "micro-section" of the stone for examination under the microscope. The first observation made is that of the shape of the crystals. While the various stone materials have characteristic shapes, it is by no means a general rule that they always crystallize in such shapes. Nevertheless, if particular shapes can be detected in the micro-section, it is possible to rule out materials which do not crystallize in the form found and, with experience, shapes are often the most useful clue. The intergrowth and development of the crystals when identified is frequently helpful in tracing origins. Other optical properties which are measured when possible include refractive index, bi-refringence, extinction and elongation, and optical sign.

In some cases, microscopic examination fails to reveal the identity of the stone. For example, the individual crystals may be too small, or it may be impossible to free them sufficiently from glass to do an accurate refractive index determination. In other cases, microscopic examination may prove successful, but it may prove a lengthy process involving the careful preparation of satisfactory micro-sections and considerable experience in the interpretation of the observed phenomena is necessary to achieve positive identification. For these reasons, when an X-ray diffraction apparatus is available, it is advisable to examine the stones by the X-ray technique as soon as the rapid preliminary examination has been made. The essential processes involved are to take an X-ray photograph and, from the lines which it records, to determine the substance which gives rise to them.

Editor's Note: Following are summaries of several papers which were presented before the 52nd Annual Meeting of the American Ceramic Society.

Determination of Calcium, Sodium and Silicate Ions in Extracts from Chemical Durability Tests on Glass

A major fault in much of the previous chemical durability work is the practice of measuring the mass effect of various components, as in the case of simple titration. It is highly preferable, from the standpoint of interpretation, to know the relative amounts of the different ions removed in a particular case. Sen and Tooley (*Journal of the American Ceramic Society*, May 1950) have, therefore, undertaken a study to (a) establish a method of determining the calcium ion that would be sensitive enough to be applied directly to extracts obtained from durability tests on glass and (b) to improve the methods of determining the sodium and silicate ions (already shown to be applicable) from the standpoint of speed and accuracy.

In the case of calcium, the oxalate-permanganate method proved to be satisfactory. It consisted essentially of precipitating the calcium ion as oxalate at a suitable pH and filtering, washing, and dissolving the precipitate in 9N sulphuric acid. Standard potassium permanganate solution was added and the excess was determined photometrically after proper dilution. The sodium zinc uranyl acetate method of determining the sodium ion and the molybdenum blue method of determining the silicate ion were also studied in order to permit their application to smaller volumes of extracts.

The developed methods were shown to be applicable to the direct analysis of the extracts obtained from chemical durability tests on glass. In the determinations, deviations from the mean were as follows: ± 0.003 mg., sodium zinc uranyl acetate method for the sodium ion; ± 0.003 mg. molybdenum blue method for the silicate ion; and ± 0.004 mg. potassium permanganate method for the calcium ion.

The Additivity of Some Practical Glass Properties

In a paper by F. R. Matson and W. A. Weyl of Pennsylvania State College, State College, Pa., it was asked: If two end-member glass compositions have values for a property that lie on either side of that desired, can it be assumed that a straight line relationship exists between these two end-members so that the composition of the glass for the desired value of the property can be calculated? In some cases such additivity is approximately true within limited composition ranges, but for many glass properties that are of industrial importance a maximum or a minimum develops at some point between the two end-members that will have a value quite different from both of them. It is important to know which glass properties are approximately additive and which are non-additive.

Several papers by Huggins and Sun have shown that the index of refraction, Abbe value and density are additive properties within limited composition ranges that are established by the silicon-oxygen ratio for certain glasses. Other authors have prepared sets of factors for many properties such as viscosity, surface tension and thermal expansion that have the appearance of additivity because the factors can be successfully employed for glasses that have a limited range of compositions such as those used for flat glass or containers. They cannot be employed when major changes in glass compositions are made.

Patents have been issued to W. H. Armistead and others that are based on non-additivity, particularly in the field of electrical properties of glass. There is also much evidence (which is cited) to show that marked changes can be obtained in the chemical durability, viscosity, electrical conductivity and limits of the field of glass formation by the partial substitution of K_2O for Na_2O or Li_2O, of MgO for CaO and by the addition of limited small amounts of additional oxides to the glass. The misnamed boric acid "anomaly" is a good example of oxide additions, for despite the water soluble character of B_2O_3, it greatly improves the chemical resistivity of glass.

Therefore, except for a limited number of properties, it is not possible to predict the changes that may *occur* when a mixture of two glass-forming oxides is used if the values for only the end-members are known. One should not be deterred from making experiments by the concept of additivity.

CURRENT STATISTICAL POSITION OF GLASS

Employment and payrolls: Employment in the glass industry during June 1950 was a preliminary 118,200. This figure represents an increase of about 2 per cent over the previous month's adjusted employment of 116,000. During June 1949 there were 105,400 persons employed in the industry—about 12 per cent less than for June this year.

During June 1950, payrolls also continued upward and were reported to be a preliminary $30,660,192. Payrolls during May were an adjusted $30,014,227, indicating an increase of about 2 per cent for June over May. During June 1949 payrolls were $25,567,000, or about 20 per cent less than for June 1950.

Glass container production, based on figures released by the Bureau of Census, fell off to 8,870,262 gross during July 1950. This represents a drop of about 2½ per cent from the previous month's 9,117,909 gross. It is believed that this drop is the first sign of the early stages of the soda ash strike which, it is expected, will be felt more heavily in the ensuing months. Glass container production during July 1949 was 8,108,218 gross, which is about 9 per cent below July this year. Total production of glass containers at the close of the first seven months of 1950 has reached 59,273,906 gross, as compared with 51,921,396 gross during the corresponding period in 1949—a difference of 14 per cent.

Shipments of glass containers for July 1950 held to the "over 9 million" mark for the third consecutive month and were 9,305,566 gross. This is only a fraction of 1 per cent below June shipments of 9,343,593 gross. Shipments during July 1949 were 7,198,226 gross, or 17½ per cent below July this year. At the close of the January-July 1950 period, shipments of glass containers have reached 58,974,027 gross. Compared with the 50,718,542 gross shipped during the corresponding months during 1949, shipments for 1950 are a little more than 16 per cent over 1949.

Stocks of glass containers at the close of July fell below a 9-million gross reserve for the first time since late last year to reach 8,931,128 gross. This might be the first indication that manufacturers are already dipping slightly into their stocks on hand to help round out the lag in production caused by the soda ash strike. Stocks at the close of June 1950 were 9,374,511 gross, and at the close of July 1949, they were 9,424,750 gross.

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

	July 1950
Narrow Neck Containers	
Foods	843,814
Medicinal & Health Supplies	1,096,797
Chemicals, Household & Industrial	554,149
Beverages, Returnable	823,926
Beverages, Non-returnable	21,387
Beer, Returnable	333,793
Beer, Non-returnable	366,672
Liquors	864,705
Wines	230,435
Toiletries & Cosmetics	475,703
Sub-total (Narrow)	5,611,381
Wide Mouth Containers	
Foods	2,351,612
Dairy Products	289,835
Home Canning	*332,851
Medicinal & Health Supplies	238,245
Chemicals, Household & Industrial	94,627
Toiletries & Cosmetics	98,089
Packers' Tumblers	124,517
Sub-total (Wide)	3,529,776
Total Domestic	9,141,157
Export Shipments	164,409
Total Shipments	9,305,566

*This figure represents Fruit Jars only.

Automatic tumbler production for July 1950 was 5,104,892 dozens. This is close to 9½ per cent below the previous month's production of 5,635,390 dozens. During July 1950, production was 4,148,363 dozens. Shipments of automatic tumblers increased about 2 per cent and were 5,830,901 during July, as compared with 5,699,315 during June. Shipments during July 1949 were 4,197,489 dozens. Stocks on hand at the close of July were 8,667,162, which is almost 1 per cent below the 8,719,106 dozens on hand at the close of June. Stocks at the end of July 1949 were 7,689,129 dozens.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production July 1950	Stocks July 1950
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	2,984,621	3,449,677
	Wide Mouth	2,753,874	2,662,030
Dairy Products		291,466	302,392
Home Canning		*250,477	329,822
Beverages, Returnable		780,250	698,905
Beverages, Non-returnable		19,779	32,781
Beer, Returnable		324,055	273,800
Beer, Non-returnable		346,957	281,787
Liquors		775,046	509,639
Wines		228,147	292,133
Packers' Tumblers		115,590	98,162
Total		8,870,262	8,931,128

*This figure represents Fruit Jars only.

Table, kitchen, and household glassware: Manufacturers' sales of machine-made table, kitchen, and household glassware were 2,324,126 dozens. This represents a drop of close to 25½ per cent from June sales of 3,117,022 dozens. During July 1949, sales were 2,528,315 dozens. Total manufacturers' sales at the close of the 12-month period ending July 1950 were 38,560,599 dozens. This is almost 2 per cent below the 39,285,651 dozens sold during the corresponding period in 1949.

The figures for automatic tumbler production and sales of table, kitchen, and household glassware of one manufacturer are estimated due to this company's inability to meet THE GLASS INDUSTRY's deadline. However, the totals for this concern have been estimated in order to complete the compilation of total industry figures. These total figures will be adjusted in the next issue of THE GLASS INDUSTRY.

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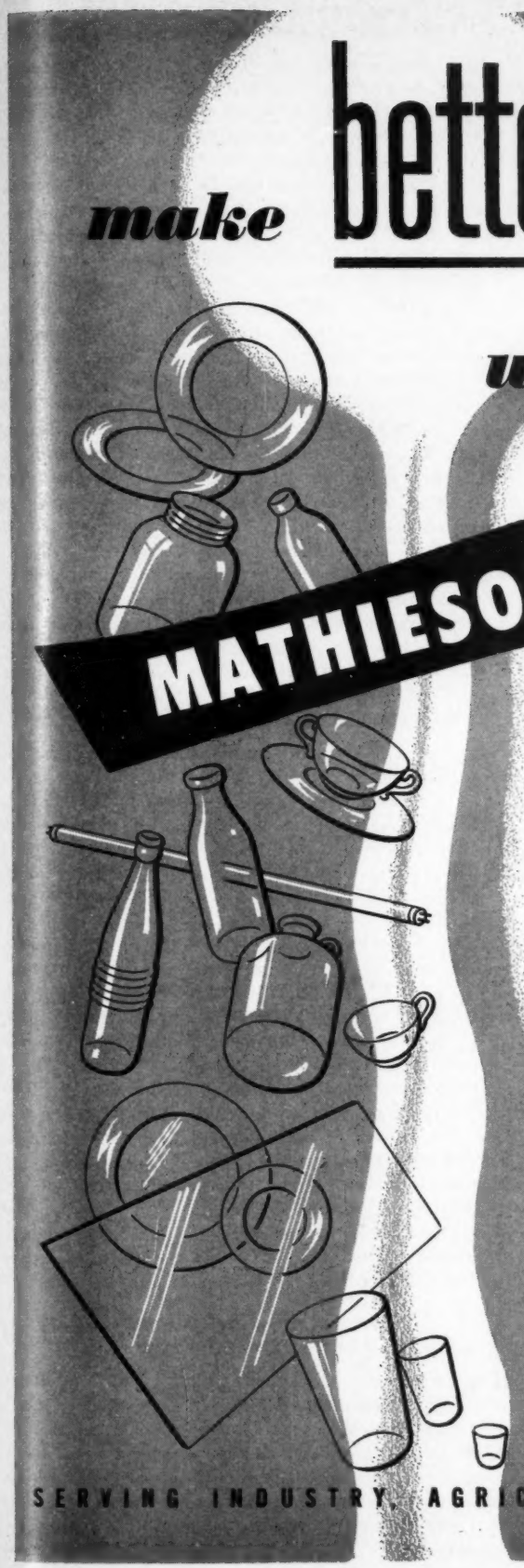

• Uniform particle size . . . high purity . . . freedom from dust—these are desirable qualities of Mathieson Dense Soda Ash that give you fast, efficient meltdowns so necessary in the production of fine glass.

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CHEMICALS

SERVING INDUSTRY, AGRICULTURE AND PUBLIC HEALTH

DUNCAN C. MENZIES TO HEAD BALL BROTHERS OPERATIONS

Edmund F. Ball, President of Ball Brothers Company, has just announced the appointment of Duncan C. Menzies, former Director of Johnson & Johnson, to the newly-created post of Executive Vice President and General Manager. With this appointment, the company makes a major change in top management. Mr. Menzies will be in charge of all manufacturing and sales activities for both the parent company and its subsidiaries and will be responsible for the management and execution of all plans, programs, and policies as they are established by the Board of Directors. He will also become a new member of the Board.

In his announcement of the appointment, Mr. Ball said that Mr. Menzies brings to the company executive and administrative experience in sales and production, as well as in all phases of industrial relations.

The new Ball Brothers executive has been with Johnson & Johnson since the early days of World War II. He has served as Assistant to the President, Chief Administrative Officer of the firm's Medical Division, was Director and Vice President of the Johnson & Johnson Research Foundation, in addition to being a Director. While serving as Director of the firm's Research Foundation, Mr. Menzies initiated and helped to develop many projects of importance to the medical profession. In recognition of his contributions, he received honors from the medical world never before conferred upon any layman. As a tribute, the American College of Surgeons had his portrait hung in their national headquarters.

Born in Scotland, he came to the United States from Canada where he had worked his way through the University of Manitoba selling hardware supplies. Upon graduation, he joined Scott Bathgate, Ltd., a Canadian firm of wholesale grocers. In 1928, when not yet 30, he opened an American subsidiary for the firm in Chicago and, later, a branch in England. He then joined Lamont, Corliss & Company, cosmetics and chocolate manufacturers, as Manager of field salesmen. He was later associated with Hecker Products Corporation, now known as Best Foods, Inc., helped organize Standard Milling Corporation and, from 1940 to 1942, was General Manager of the Flour and Cereal Division of the Hecker Corporation.

MISSISSIPPI GLASS HALF-YEAR REPORT

Net sales of Mississippi Glass Company during the first six months of 1950 amounted to $4,116,882, as compared with $3,689,691 reported for the same period in 1949.

Net earnings for the first six months of 1950 were $313,893, as compared with $213,700 in 1949, an increase of 46.89 per cent.

COLUMBIA CHEMICAL SIGNS THREE-YEAR UNION CONTRACT

The Columbia Chemical Division of Pittsburgh Plate Glass Company has signed a three-year closed contract with Allied Chemical Workers, independent, at the firm's Barberton, Ohio plant, according to H. O. Eby, General Labor Relations Director for the firm.

Union employees were granted a five cents an hour (5¢) general wage increase immediately, five cents more on June 28, 1951, and a third wage hike on June 28, 1952. All provisions of the new agreement will remain in effect during the three-year life of the agreement.

In addition to the wage increase, the company has granted improved shift differentials, increased group hospitalization benefits, and three-week vacations to employees with twenty years service. Also granted was a pension program providing for old age retirement and disability pensions for eligible employees who become unable to carry on their work. A new feature of the arbitration procedure will result in a permanent panel of three arbitrators who will serve during the life of the agreement.

The three-year contract without a reopening clause is without precedent in the chemical industry in Barberton-Akron district. About 1400 employees are covered by the new agreement. Earlier in the month, Columbia signed a two-year contract with the AFL Chemical Workers at the company's Natrium, West Virginia plant.

CANADIAN GLASS ANNUAL REPORT

The latest annual report on the glass industry has just been disclosed by the Canadian Government and it shows a general gain in all directions for such operations in Canada, though the number of plants in this industry dropped to 95 in 1948 compared with 96 in preceding year. The average number of employees advanced to 5,918 in 1948 against 5,827 in previous year, up 1.6%, and the salaries and wages paid reached $12,496,695 against $10,499,750, a gain of 17.9%. Likewise, cost of fuel and electricity at works increased to $3,098,019 in 1948 against $2,348,535, up 31.9%; cost of materials at works rose to $15,100,702 against $13,791,877, up 9.5%, and gross selling value of products at works increased to $40,364,428 against $36,459,853, up 10.7%.

Products made in the industry included $11,599,719 in 1948 in the cut and beveled glass division compared with $11,103,415 in previous year, and $28,764,709 in the pressed, blown and drawn glass division as against $25,356,448. Materials used in manufacturing cut and beveled glass division declined to $4,955,550 in 1948 against $4,976,228 in preceding year, and in the pressed, blown and drawn glass division rose to $10,145,152 in 1948 as compared with $8,815,649 in previous year.

SECRETARY OF WALSH REFRACTORIES DIES

Albert M. Menzi, 58, Secretary of the Walsh Refractories Corporation, died on July 29.

A member of the American Bar Association, he also served as attorney for the company and was, for many years, Secretary of the Missouri Group of the American Refractories Institute. Mr. Menzi was also past Lt. Governor of Division 1, Kiwanis, and a member of the Missouri Athletic Club. Surviving is his widow, Hilda A.

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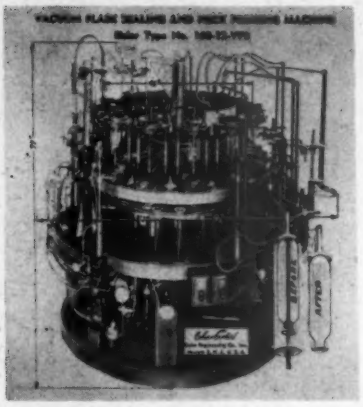


AUTOMATIC VACUUM FLASK SEALING MACHINE

Eisler Engineering Co., Inc., 750 S. 13th Street, Newark 3, New Jersey, has recently placed on the market a motor-driven automatic sealing machine developed for uniform and increased output of vacuum flasks.

The machine is used to join the inner shell to the outer shell of vacuum flask at its mouth. Twelve heads are located on circle of 45″ diameter. Intermittent motion of fabricated turret is provided by a barrel cam, which is immersed in oil in an enclosed housing and built-in reducer located in separate housing under fabricated table. Continuous uniform rotation to heads is produced by double V-belt drive with variable speed feature.

Head stops permit heads to remain stationary at load, mold, and discharge positions. Heads have two-jaw chucks to centralize glassware, which is loaded manually, inner and outer shell simultaneously with mouth down, through top of chuck on to seal rod. A feature of the machine is the complete independence between the drives of the turret and heads.

The machine has two motors with variable speed drive for operating head and indexing turret drives, ¼ and ½ H.P. motors required, respectively. Two switches for use on 220 volts, 60 cycles, 1 or 3 phase. Head speed may be adjusted from 30 to 50 R.P.M. Production is approximately 250 to 400 seals per hour. The inner shell must have flared mouth to facilitate seal operation.

WESTINGHOUSE IONIZATION GAUGE

Westinghouse Electric Corporation, Bloomfield, New Jersey, has announced the development of a new ionization that can be used to measure pressures as low as $5X\ 10^{-10}$ mm. Hg.

Resembling a triode vacuum tube structurally, the new gauge has the usual three elements — filament, grid, and ion collector—but these are inverted from the conventional arrangement. The filament, of which there are two (one being a spare), is outside the cylindrical grid, while the ion collector, consisting of a fine wire, is within the grid.

The volume thus enclosed by the grid is made comparable to that between the grid and plate of the ordinary ionization gauge. The positive potential on the grid forms a barrier to the ions formed inside the grid-enclosed volume so that they are eventually collected at the center wire. The ion collection efficiency is thus comparable to that of the conventional ionization gauge. Since the number of ionizing collisions for a given electron current is considered to be proportional to the gas density, the current on the ion collector is thus a measure of the pressure.

The construction used in the new gauge reduces the metallic surface to a minimum. This feature makes it easy to outgas the elements by electron bombardment at temperatures above 1000°C. with power less than 100 watts. The hard glass enclosure is 2 inches in diameter by 5 inches high. The new gauge can be operated on standard power supplies and will be furnished with special tabulation for direct reading to various types of glass systems.

S-A BOX CAR UNLOADER

Stephens-Adamson Mfg. Company, Aurora, Illinois, has announced its S-A box car unloader to handle sand, dry chemicals, and practically all bulk materials up to 2-inch lump size.

A pantograph arm equipped with a scoop reaches into the car until it meets an obstruction, drops down and withdraws a load of material, discharging it to a track-side hopper. This cycle continues automatically, the single operator taking only enough time from other tasks to direct the arm to different sections of the car. A brush attachment snaps to the scoop for final clean out of the car. An unloading operation can be completed in only one half an hour.

The new unloader occupies an area of 5′6″ by 14′2″ when not in use and requires only a single concrete footing for track-side mounting. Conventional rotary or tilting car dumps occupy considerably more space and require the operator's full attention at all times during the unloading cycle. The new box car unloader is described in Bulletin 549 available through the company.

MAGNETIC LATCH

Laboratory Equipment Corporation, St. Joseph, Michigan, is distributing its Leco-Latch, utilizing the continuous energy of the permanent magnet.

The complete unit consists of a small but powerful permanent magnet, a small plate made of special steel, and necessary screws. It has no moving parts, no springs, and is easily installed. It holds doors in place firmly and allows them to be opened easily.

CATALOGUES RECEIVED

The Texas Company, 132 East 42nd Street, New York 17, New York, is making available to interested persons in the glass industry copies of its publication "Lubrication" which this month is devoted to "Lubrication of Glass Making Machinery".

The entire issue of Lubrication is devoted to glass making and includes discussions of bottle making machinery, window glass manufacture, and plate glass manufacture. Pressing operations, lehrs, speed reduction gears, and materials handling methods are discussed.

Bristol Company, Waterbury 20, Conn., has published a 32-page bulletin on its Series 500 line of recording gauges.

Complete information is given in this Bulletin G 621 on pressure gauges for ranges from 0 to 2 inches of water to 0 to 10,000 pounds per square inch, vacuum gauges, low range draft and pressure gauges, barometers, and absolute pressure gauges for ranges as low as 0 to 6 millimeters of mercury absolute. Measuring elements, operating principles, recording charts and accessories for the various types of recording gauges are fully described.

Information is also included on Bristol instruments for automatic controlling and telemetering of pressure and vacuum values. In addition to numerous photographs, the bulletin is illustrated with reproductions of actual charge records and sketches of applications of the instrument.

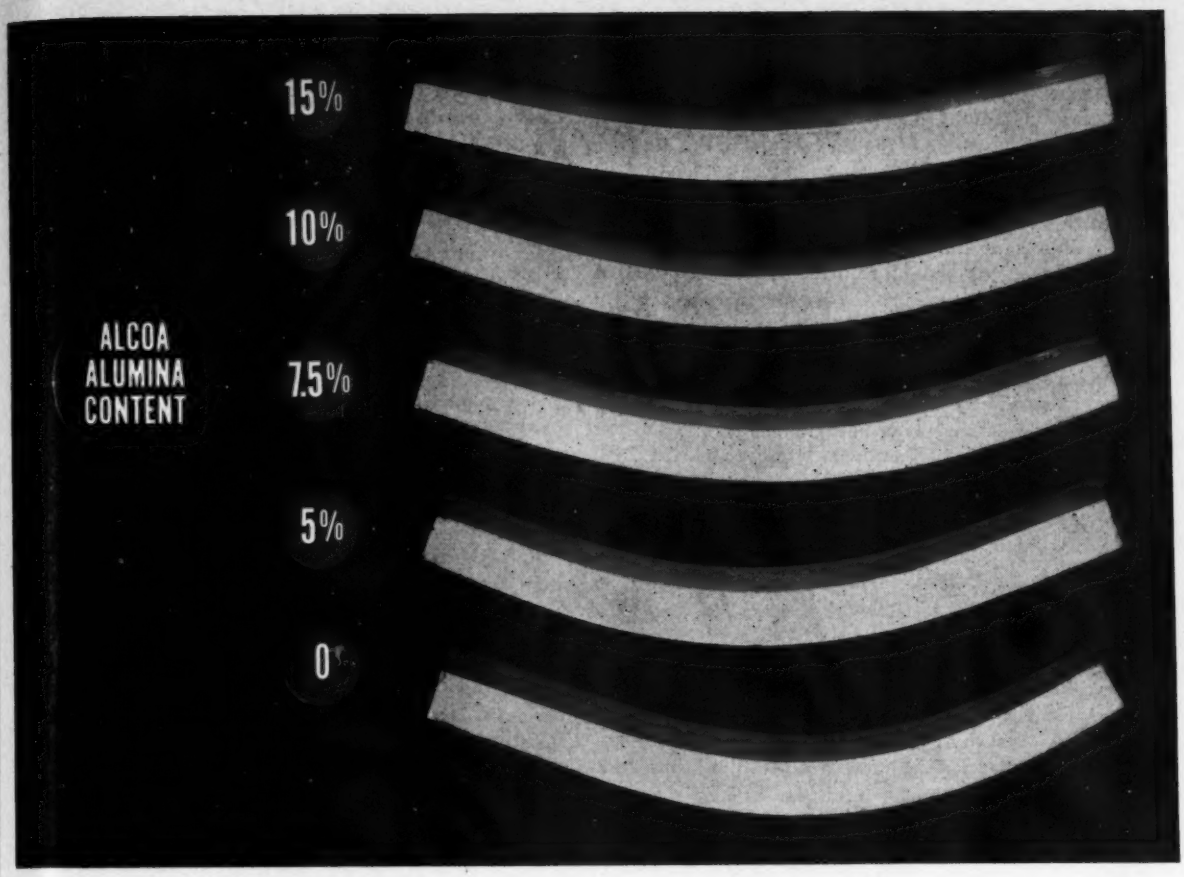
Stephens-Adamson Mfg. Company, Aurora, Illinois, has issued a bulletin on its 5-A circular bin discharger.

The bulletin, No. 250, shows a typical installation, both photographically and by cut-away line drawing. The operation is described with photographs pointing up the features discussed. Capacities and discharger speeds, power required, materials handled, diameters of dischargers, etc., are all discussed editorially, plus additional photographs of installations.

Hauck Manufacturing Company, 124-136 Tenth Street, Brooklyn 15, New York, has issued Catalogue 456 describing the Hauck Venturi High Pressure Steam or Air Atomizing Oil Burner for industrial firing applications.

How the higher operating efficiency is obtained with the Venturi principle in atomizing oil is explained in the phantom photo, drawing and text which appears on Page 2 of the catalogue. The three flame types (cylindrical, conical and flat) enable the selecting of the burner best suited the job requirements.

The bulletin includes tables showing oil capacities for the different flame types and is well illustrated with close-ups of the burners.



See what a difference a little Alcoa Alumina makes

All five of these ceramic specimens were fired at 2320° F. in about 30 hours. Cone 10 averaged 5 o'clock at the end of the firing. *Yet look at the difference in deformation.* The ALCOA ALUMINA content ranged from 0% (bottom specimen) to 15% (top specimen). *The addition of 15% Alcoa Alumina resulted in a 38% decrease in deformation!*

ALCOA ALUMINA adds strength to refractories, porcelains and other types of ceramic bodies. The more ALCOA ALUMINA you add, the higher the temperature a refractory can withstand. But even at "moderate" temperatures, a *little* ALCOA ALUMINA makes a marked difference, as shown by these test bars.

ALCOA ALUMINA improves refractories and other ceramics in a number of ways. It gives them:

- **Better stability under load at high temperatures.**
- **Lower coefficient of expansion.**
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- **Negligible porosity and shrinkage.**
- **Better resistance to spalling at high temperatures.**
- **Better resistance to corrosive slags and gases.**

WE DO NOT MAKE REFRACTORIES or other kinds of ceramics. But more and more, leading manufacturers are adding ALCOA ALUMINA to their mixes to improve the performance of such products.

We have considerable data concerning the value of ALCOA ALUMINA in ceramics. Some of this information may be of interest to you. Let us discuss it with you. Write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 613-J Gulf Building, Pittsburgh 19, Pa.

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NEW RADIATION-ABSORBING GLASSES DEVELOPED AT UNIVERSITY OF PITTSBURGH

Researches at the University of Pittsburgh have resulted in several new radiation-absorbing glasses which seem to possess immediate importance for protecting the eyes of atomic-energy, atom-bomb, and hydrogen-bomb workers to prevent radiation cataracts, from which some workers have already suffered. It would also seem to be desirable for the populace at large in case direct or wafted radiations should result from atomic bomb or hydrogen bomb attacks, or from atomic energy plants which are already in contemplation or under construction by manufacturers of electrical equipment. Cyclotrons, betatrons, etc., have been built at a number of universities and by the United States Government.

The first glass, developed by Joseph J. Rothermel, Kuan Han Sun, and Alexander Silverman, is a high-energy X-ray or gamma-ray absorbing glass containing tungsten phosphate. Its radiation-absorbing power is 50 per cent greater than that of previously existing commercial X-ray shielding glass, and does not discolor on exposure to the rays.

The second glass, developed by Laben Melnick, Hurd W. Safford, Kuan Han Sun, and Alexander Silverman, is a slow-neutron absorbing glass containing cadmium boro-silicates with fluorides. Its slow-neutron absorption is one-third that of pure cadmium sheet which is opaque. In other words, the new glass in a layer three times as thick as cadmium sheet affords equal but transparent protection for the eyes against slow neutrons.

Both glasses should prove desirable for heavy transparent laminated peepholes in the safety barriers in atomic-energy plants, as suggested by the University. The glasses can be used in optical instruments which are employed in these plants and in science laboratories where radiation studies are made. Goggles containing laminated lenses for both X-rays and neutron absorption are a possibility or single lenses might be worn for protection against X- or gamma-rays only.

NEW A.S.T.M. COMMITTEE FORMED; NATIONAL MEETING DATES SET

The Board of Directors for the American Society for Testing Materials has authorized the formation of a new technical Committee on Sampling and Analysis of Atmospheric Pollution. Dr. Louis C. McCabe, Chief of Air and Stream Pollution, U. S. Bureau of Mines, has accepted the temporary chairmanship of the new committee.

Announcement has also been made of the date of national meetings to be held during 1951 and 1952. The 1951 Spring Meeting and Committee Week will be held March 5 through 9 in Cincinnati, Ohio; the 1951 Annual Meeting to be held June 18 through 22 in Atlantic City, New Jersey. During 1952, the A.S.T.M. Spring Meeting and Committee Week will be held March 3 through 7 in Cleveland, Ohio, and the Annual Meeting will be held June 23 through 27 in New York City.

• The appointments of Homer H. Ewing, Luis de Florez, and James C. Zeder to the National Inventors Council have been announced by Secretary of Commerce Charles Sawyer. Chairman of the Council is Dr. Charles F. Kettering.

THATCHER GLASS RAISES PRICES

New price schedules, advancing the prices on its entire line of containers effective August 15, have been announced by the Thatcher Glass Manufacturing Company, Inc.

Commenting on factors necessitating increased prices, Franklin B. Pollock, President of Thatcher Glass, pointed out that new labor contracts provided for an increase in labor costs approximating 10 per cent; that the prices on corrugated boxes which are used to package the company's products had increased approximately 10 per cent effective August 1 and that in some lines corrugated box costs represent 30 per cent of the selling price of glass containers; that raw materials and miscellaneous supplies had increased in varying amounts, some of which were: soda ash 10 per cent, effective July 1; selenium 12½ per cent; barytes 6⅔ per cent; miscellaneous materials and supplies 12½ per cent. Altogether, he estimated that the items of labor, raw materials and supplies, and corrugated boxes comprise 76 per cent of Thatcher's selling prices of glass containers, and that these items have increased in cost from 6⅔ per cent to 12½ per cent.

Mr. Pollock emphasized that the new price schedules do not take into account the tremendous increases in cost attributable to the soda ash strike which has been in effect for two months. The costs embodied in curtailment of production, extremely high prices for cullet and imported ash have not been considered in establishing these new price schedules.

INSTITUTE OF RADIO ENGINEERS TO HOLD SEMINAR

The eleventh annual seminar of the Emporium Section of the Institute of Radio Engineers will be held August 18 and 19, according to an announcement by W. James Peterson of Sylvania Electric Products, Inc., Chairman of the Emporium Section.

Speakers during the technical sessions will include Norman Pickering, Pickering Company, who will discuss high quality audio reproduction; C. Wesley Carnahan, Sandia Corporation, who will speak on the application of electronics to remote control devices; Dr. R. M. Bowie, Sylvania Electric Products, Inc., who will report on color television; and Dr. E. M. Geyer, Corning Glass Works, who will discuss the electrical characteristics of glass.

AMERICAN POTASH FIRST-HALF REPORT

American Potash & Chemical Corporation has reported net earnings for the six-months' period ended June 30, 1950, of $1,035,907 compared with $797,732 for the corresponding period in 1949. After allowance for preferred dividend requirements, earnings on the Class A and B stocks amounted to $1.70 per share for the first half against $1.25 for the same period in 1949. Sales for the first six months of 1950 were $7,536,736 against $6,605,138 in 1949.

The company also reported net income for the second quarter of 1950 of $491,169, or 80 cents per share on the Class A and B stocks, against $406,320, or 64 cents a share for the same quarter in 1949.

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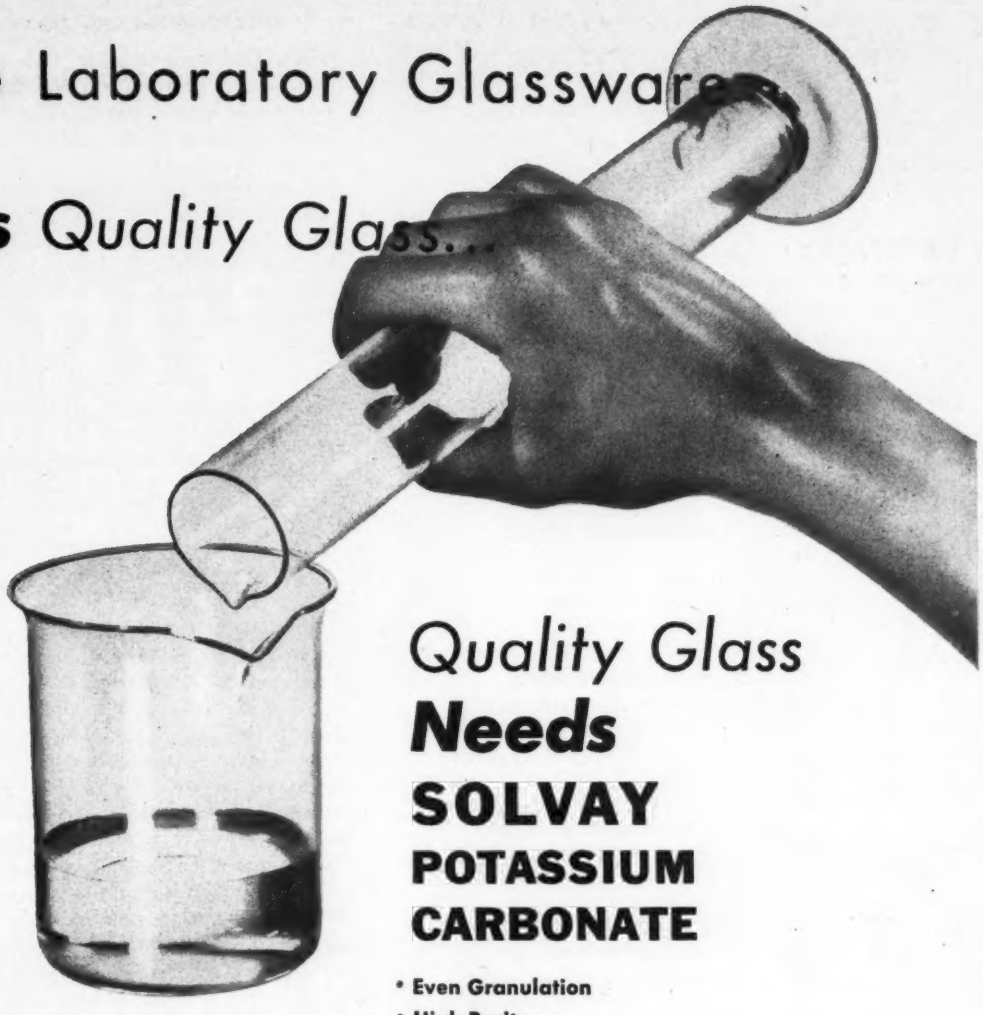

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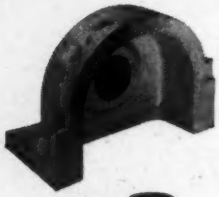

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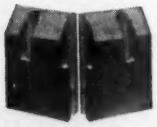

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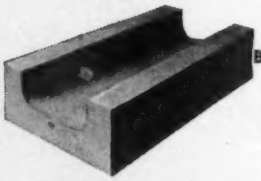

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Uniformity, accuracy, and structural quality combine for longer productive life.

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FOREIGN GLASS CONTAINER NEWS

Cuba: The three leading Cuban beer manufacturers have placed orders for 6,000,000 bottles with Cuba's only bottle manufacturer. The brewers had until recently refused to obtain their requirements from the local supplier claiming that the quality and price of his product were not competitive. Although the bottle manufacturer, who is reportedly installing new equipment, attempted to obtain an order for a year's supply, the brewers placed trial orders of 2,000,000 each and will place future orders in accordance with the results of this initial order.

Japan: Japanese production of glass containers during 1949 increased greatly over the 1948 level, according to data released by the Economic and Scientific Section, Supreme Commander for the Allied Powers. Production of several types of glass containers, in metric tons, for 1948 and 1949 was as follows:

Type of container	1948	1949
Beer and beverage bottles....	6,050	16,675
Glass food containers.....	20,004	33,003
Glass medical containers.....	34,701	43,369

Peru: Peruvian production of glass beverage bottles increased appreciably during 1949 and met the growing demand of the market, according to trade sources. Continued heavy consumption of both alcoholic and non-alcoholic beverages, installation of new bottle manufacturing plants, adequate supplies of raw materials, and import restrictions still in effect were regarded as the principal reasons for higher production. Bottle manufacturers are of the opinion that the outlook for 1950 is encouraging since demand in the domestic market is expected to remain strong and prospects for export of bottles to neighboring countries are considered good. It was reported that during the past year Ecuadoran producers of soft drinks placed small trial orders and it is believed that a larger volume of orders will be placed during 1950.

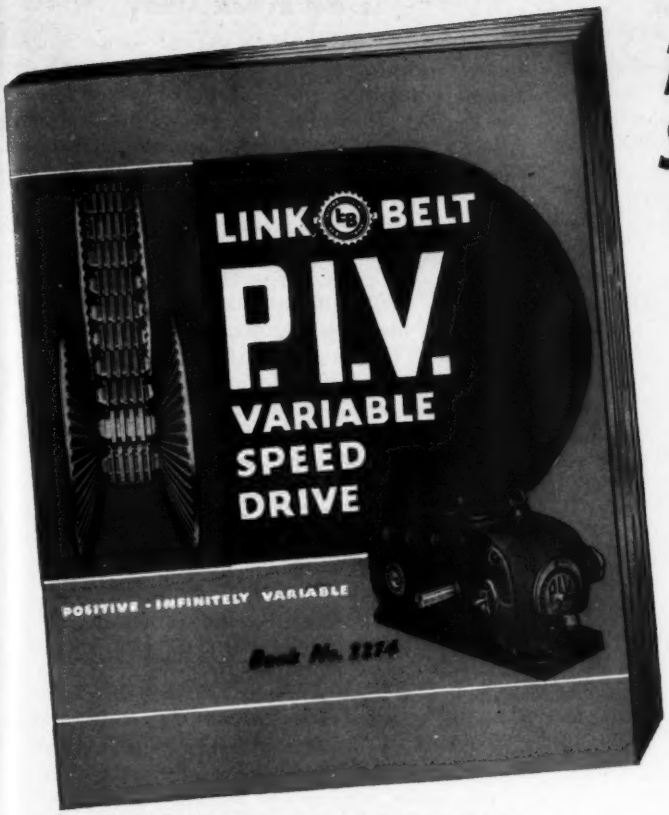
Philippines: The San Miguel Brewery Glass plant in Manila, with one furnace and four molding machines, produces 60 tons of glass containers daily, equivalent to 150,000 bottles, according to the foreign press. When the second and third furnaces are placed into operation, daily production is expected to reach 500,000 bottles.

FOOTE MINERAL ADDS TO RESEARCH STAFF

Dr. Holger C. Anderson, formerly Research and Development Director for Hastings and Company, and Lawrence J. Reader, formerly Senior Inorganic Research Chemist with General Chemical Company and Wyandotte Chemicals Corporation, have joined the staff of the Research Laboratories of Foote Mineral Company, according to an announcement by Dr. S. C. Ogburn, Jr., Director.

Dr. Anderson, who was for a time Research Group leader with Kellex Corporation, graduated from Northwestern University and received his Ph.D. in Physical Chemistry from Harvard. Mr. Reader received his B.S. and M.S. degrees from the University of Minnesota.

L. H. Belz and Harvey Stewart, Jr., have also been added to the research and development staff.



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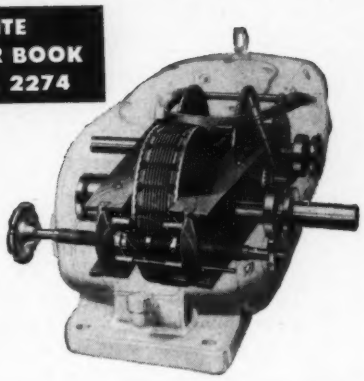

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Wherever speed is a factor in manufacturing operations or processes, the supremacy of the Link-Belt P.I.V. variable speed drive becomes readily apparent, as a means of providing precise control, instantly variable, and reliably constant over long periods. Power is transmitted from input to output shaft through a *unique chain* which makes *positive* engagement with radial grooves on two pairs of opposed driving wheels. Movement of the control screw simultaneously varies the effective diameters of these wheels. Thus an infinite number of *stepless* speed adjustments is possible between maximum and minimum settings. Because it is entirely independent of frictional elements, the P.I.V. variable speed drive *eliminates slip or creep*, ends costly guess work or hunting and extends the range of operations for greater efficiency and higher production.

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OPTICAL SOCIETY TO HOLD ANNUAL MEETING IN CLEVELAND

The Optical Society of America has announced that its thirty-fifth annual meeting will be held at the Hotel Statler, Cleveland, Ohio, on October 26, 27, and 28.

In addition to contributed papers covering all phases of optics, special invited papers will include the following: "Growing Optical Crystals from the Fused Melt," by H. C. Kremers, Harshaw Chemical Company; "Growing Large Barium Titanate Crystals," by H. D. Williams, Harshaw Chemical Company; "The Properties of Large Barium Titanate Crystals," by A. de Bretteville, Jr., Squire Signal Corps Engineering Laboratories; "Polarizer, Polarizing Beam Splitter, and Birefringent Elements, and Some Optical Systems in Which They Enter," by C. D. West, Polaroid Corporation; "Some Experiences in the Production of Large Clear Crystals from Solutions," by Bengt Kjellgren, Brush Development Company; "Optical Aspects of Piezoelectric Crystals," by Hans Jaffe, Brush Development Company; "Reversibility and Irreversibility in Optics, or, Is Optics Possible," by R. Clark Jones, Polaroid Corporation; and "Michaelson as a Man and as a Scientist," by R. S. Shankland, Case Institute of Technology.

On Friday afternoon, October 27, the Society will be the guest of the General Electric Company at Nela Park. A tour of the Lighting Institute is being arranged and the following invited papers will be presented: "Brightness Relationships for Comfortable Seeing," by S. K. Guth, Lamp Department, General Electric Company, and "Lamp Quality Optical Inspection Equipment," by George Fabritius, Lamp Department, General Electric Company.

Arrangements are being made for a trip to the Case Observatory on October 26, at which time Professor J. J. Nassau, of the Case Institute of Technology, will speak on "Schmidt Optics in Astronomy."

STAUFFER CHEMICAL ADDING NEW RESEARCH LAB TO FACILITIES

Stauffer Chemical Company has announced that construction of a new Research and Development Laboratory at Dobbs Ferry, New York, is under way. When completed, the building will house the research staff of the company's Eastern Division now scattered at several locations in and around New York City.

Located next to the Sawmill River Parkway, the building will provide five large laboratories for various research projects, administrative offices, technical library, work shop and storage and service areas. All rooms and laboratories will be air-conditioned and equipped with a wide variety of the most modern equipment.

The firm's Chauncey plant is located across the Parkway and will furnish facilities for pilot plant testing of products and processes developed at the new laboratory. Mr. John F. Crowther, Director of Stauffer's Eastern Research Division, will be in charge.

• Chester H. Butterfield, Vice President of Manning, Maxwell & Moore, Inc., has been named Vice President in Charge of the Consolidated-Ashcroft-Hancock Division, makers of valves, gauges, and industrial instruments. Mr. Butterfield succeeds Hamilton Merrill, who was recently elected president of the company

L-O-F STOCK SPLIT

A two-for-one stock split of capital shares of Libbey-Owens-Ford Glass Company was approved with only one and two-tenths per cent dissenting vote at a recent special meeting of shareholders. The split became effective upon the filing of the amended articles of incorporation adopted at the meeting in the office of the Secretary of State of Ohio on the afternoon of August 25.

Directors at a later meeting declared a dividend of $1 per share on the new shares payable September 11 to holders of record September 1. For each old share represented by certificates standing in a shareholder's name as of the close of business on Sept. 1, such shareholder will receive the dividend on two of the new shares. On March 10 and June 10 the company paid $1 dividends on the old stock. Record-breaking earnings of $15,063,850 for the first half of 1950 amounted to $2.94 a share on the basis of the new shares.

Shareholders will be notified regarding exchange of the new share certificates for old as soon as necessary details are completed and the permanent new certificates are available, a company announcement said. The shares will be listed on the New York Stock Exchange. When the new shares are distributed to the nearly 19,000 shareholders there will be 5,128,476 shares outstanding with total capital value of $51,284,760.

Along with the two-for-one split, the shareholders approved an increase in authorized number of shares from 3,500,000 to 10,000,000 with par value of $10 each. Nearly 74 per cent of the shares were represented at the meeting either in person or by proxy.

John D. Biggers, President, said the change in par value of shares brings the Libbey-Owens-Ford capital account into a more realistic relation to the nature and growth of the company operations and to the amount of capital permanently necessary to carry on its business.

In line with the pattern set in World War II when Libbey-Owens-Ford undertook a vast production program wholly unrelated to normal peacetime production, the company presently is studying military requirements for the Korean situation, and plans are in the making to meet whatever demands may be made upon the company in the interest of national defense. In its World War II operations, Libbey-Owens-Ford turned out more than 26,000,000 pieces of wartime equipment, ranging from tiny precision glass items to entire aircraft assemblies, and supplied more than 23,000,000 pounds of specialized Plaskon resins.

OWENS-ILLINOIS REPORTS SHARP EARNINGS GAIN

Net profit of Owens-Illinois Glass Co. and subsidiaries in the 12-month period ended June 30 amounted to $21,986,895, up $8,982,341 from the corresponding period a year ago, J. P. Levis, Chairman, reported at a meeting of O-I directors.

The net was equivalent to $7.19 on 3,056,874 common shares outstanding, compared with $4.25 a share in the previous period.

Sales and other revenue of the corporation reached $239,556,592 in the latest period, representing an increase of $17,730,204 over the previous 12 months, Mr. Levis said.

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Matthey Decals for glass give you multicolor decoration of the finest quality. Delicate or bold designs carry a thick deposit of enamels giving a rich decoration of remarkable brilliance and durability.

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JOHNSON MATTHEY & CO. LIMITED, HATTON GARDEN, LONDON E.C.I. ENGLAND

Cables: "MATTHEY SMITH" LONDON

INVENTIONS AND INVENTORS . . .
(*Continued from page* 469)

proximately 0.5 per cent of finely divided carbon and about 0.1 to 0.2 per cent of calcium sulfate calculated as ½ hydrate, placing the mixture in molds and heating the mixture to the sintering point of the glass to form coherent cellular bodies, and cooling and annealing the bodies.

The only reference cited by the Patent Office was British Patent No. 447,805 of 1936.

Method of Making Microwave Tubes. Patent No. 2,513,207. (One sheet of drawings, none reproduced here.) This invention by Walter van B. Roberts is assigned to the United States of America.

The single claim of the patent is: The method of making a microwave tube having closely spaced tube electrodes ring-sealed in a tube envelope; said method comprising re-spacing said tube electrodes within said envelope after said tube is finished, by adjusting to a properly spaced set of test electrodes; said method including the following steps: forming said tube so that said tube electrodes are spaced apart at a distance greater than that ultimately desired; maintaining a continuous non-visual indication of the interelectrode capacity of tube electrodes by means of an oscillator and a receiver circuit; using said capacity as the capacitance of said oscillator so that said capacity affects the frequency of said oscillator; holding a properly spaced set of unsealed tube test electrodes in operating connection with said circuit; thereafter adjusting said receiver to zero beat; applying heat to soften a portion of said tube adjacent said tube electrodes; moving said tube electrodes within said softened portion until they attain a re-spaced position at which said oscillator is heard on said receiver; removing said heat from said portion; and retaining said tube electrodes in said re-spaced position until said portion has re-hardened.

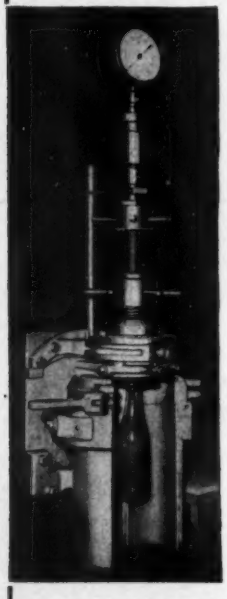
The following references are of record in the file of this patent: United States Patents: 2,374,546, Laico, Apr. 24, 1945; 2,402,119, Beggs, June 18, 1946; 2,428,610, Beggs, Oct. 7, 1947; and 2,452,652, Hansen, Nov. 2, 1948.

CANADIAN GLASS NEWS

The Canadian Government has reported that imports of glass and glassware advanced to $2,679,000 in May compared with $2,102,000 in May last year and reached a total of $11,195,000 in first five months this year as against $10,220,000 a year ago.

The Government also reported that its latest survey shows that the glass products manufacturing industry had 5,728 employees classed as wage-earners at May 1, 1950 and their average hourly earnings advanced to 98.2¢ on that date compared with 98.1¢ at April 1 and 91.2¢ at May 1 last year. The average weekly wages rose to $45.07 at May 1, 1950 compared with $41.50 on the same date last year. The average hours per week reported at May 1 was 45.9 as against 46.1 at April 1 and 45.5 at May 1 a year ago.

MAXIMUM INDICATION GAUGE with Manual Reset Free Pointer



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O. N. Break Type **BOTTLE TESTER**

Wheel to seal Bottle Gasket

Latch to Lock Safety Shield

- **BREAKING PRESSURE** is temporarily recorded by a manual reset free pointer.
- **ACCURATE TESTS** are obtained. No increment factors are involved, as with testers using weights.
- **TESTING IS SAFE** as the bottle breaks inside of a safety shield and the parts drop harmlessly into a container.
- **TESTING IS FAST** as there are no weights to handle and the required operations are simple and convenient.

UNIT FOR TESTING VARIOUS KINDS AND SIZES OF CONTAINERS

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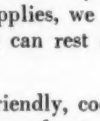

Drakenfeld

(*Continued from page* 465)

can be examined and their performances evaluated in a manner particularly useful to lens designers. Interferometric techniques are also employed in a new precision method being developed at the Bureau for measuring the planeness of optical surfaces. In this method, a topographic map of the surface is recorded photographically. As light waves are used as standards of length, the contour interval may be less than one-millionth of an inch.

Range Finders

The most complex of all optical instruments is the optical range finder, used by the armed services to measure the distance from an observer to a target. In this device, the number of residual errors which remain to be corrected is so large and the individual errors are so small and so nearly equal in magnitude, that it is impossible to separate and identify them from observations of terrestrial targets. Thus, in development work for improvement of range-finder performance, these residual errors must be studied separately in the laboratory, with adequate control of all environmental conditions such as temperature, exposure to directed radiation, and orientation with respect to the gravitational field.

The National Bureau of Standards has therefore built a special range-finder testing laboratory under the sponsorship of the Army Ordnance Department. Equipped with a precision collimator system which optically simulates a target for eight different ranges at any desired elevation, this laboratory—the only one of its kind in this country—provides for testing under conditions corresponding to a wide range of climate and permits the complete analysis of the behavior of a range finder with a thoroughness and facility impossible with outdoor targets.

A range finder is essentially a double-telescope system in which the entrance pupils are widely separated at a known fixed distance, the "base length" of the instrument, while the oculars are spaced for binocular use by a single observer. Range is obtained by a triangulation method, in which the rays proceeding from the target to the entrance pupils form a triangle with the base length of the instrument itself.

To obtain the necessary precision, the target-simulating apparatus must produce two collimated beams separated by the base length of the range finder (13½ to 15 feet) and departing from parallelism by an angle accurately known within one-half second. This precision must be independent of large temperature variations and movements of the apparatus to vary the apparent elevations of the target. Such rigorous requirements have been met by mounting the collimator instrument in an insulated chamber which can be maintained at any fixed temperature between 0° and 100°F. The chamber may also be subjected to a preassigned rate of temperature change. Directed radiation from the sun comparable to that received under service conditions is simulated by a cylindrical mirror of paraboloid cross section extending the length of the range finder. Environmental conditions are thus under complete control at all times.

In the short time that the range finder laboratory has been in operation at the Bureau, range finders of foreign origin and improved prototype models, as well as those in use by the Army and Navy, have been tested under a wide variety of conditions. Results that formerly required outdoor tests are now obtained with a great saving of time, and measurements which previously could not be made have become feasible.

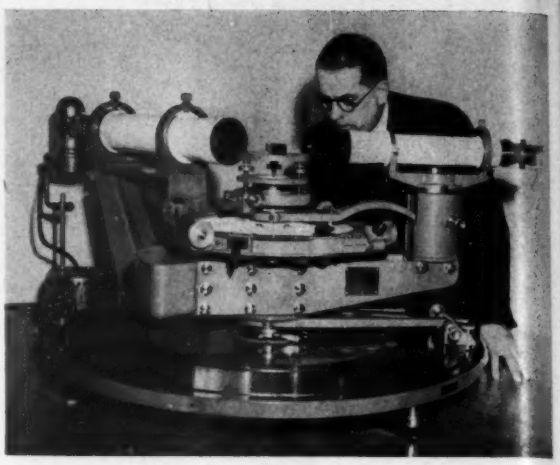

Fig. 9. This high-precision spectrometer determines the refractive index of transparent materials used by the Bureau in standardizing industrial refractometers. Monochromatic light from the source at the extreme left is rendered parallel by the adjacent collimating tube. It then passes through a 60-degree prism of the material under examination, where it is deviated through an angle which depends upon the refractive index of the prism. The deflection of the beam, as observed in the telescope at right, is read on the large graduated circle below the prism table.

As a result of this work, it has been possible to clarify the many different types of error occurring in a range finder and to make quantitative studies leading to their correction or compensation. Components of range finders have been tested separately to determine their contribution to over-all performance, and improved components having reduced errors have been developed. Range-finder design has thus been given a firm engineering basis, and the paths along which future development should proceed have been clearly indicated.

Optical Shop

To aid in the work on optical instruments, the Bureau maintains a modern optical shop. In general, this shop does not attempt to utilize production methods but specializes in making very precise optical components or custom-made optical systems in accordance with the Bureau's own designs.

Recently, the requirements of wind-tunnel optics, a new field concerned with wind-tunnel instrumentation for supersonic velocities, have created a need for large optical components of extreme precision for use in interferometers and Schlieren apparatus. Glass disks 36 inches in diameter are often employed, and even larger constructions have been contemplated. The optical shop has been called upon to make large interferometer plates, beam splitters, and aspheric lenses for this purpose. Off-axis parabolic mirrors, another type of aspheric surface now important in infrared spectrometry, have also been constructed with diameters up to 8 inches.

As interferometric methods of testing surfaces and

measuring lengths are in general use throughout the Bureau, a large part of the work of the optical shop consists in supplying optical planes of various sizes and their restoration when they become badly scratched through use. In making a first-class transit theodolite, an optically plane metal blank is necessary for the graduated circle if the graduations are to be sufficiently accurate: errors should be no greater than one or two seconds of arc. The optical shop has devised methods for producing such surfaces and also for bringing the locating shoulders of a graduated circle into optical parallelism with the surface to be graduated. During World War II the Army Engineer Board undertook the development of European-type precision transits with graduated circles not more than 4 inches in diameter. The optical shop produced the metal blanks for the circles used in the earlier instruments and also made the glass blanks required for the later models.

The making of graduated circles is but one example of the Bureau's use of precise optical methods to produce parts for use in other fields. Other examples include the production of high-precision decimeters and other length standards of fused quartz, accurate cores for inductances, and precise spheres to serve as standards of curvature.

In connection with the work of the optical shop, the principles underlying the polishing of glass are now being intensively investigated. In addition to a study of the effects of different polishing agents and methods of application, an attempt is being made to learn more about the fundamental nature of the polishing process. Each crystalline material requires a special technique for the production of an optically regular surface and a good optical polish. At present a large number of new synthetic crystals are becoming increasingly important because of their refraction or transmission characteristics, and the development of suitable techniques for polishing them is also a matter of special study at the Bureau.

[1] For more complete details, see Research and development in applied optics and optical glass at the National Bureau of Standards, by Irvine C. Gardner and C. H. Hahner, National Bureau of Standards Miscellaneous Publication 194, available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 15 cents a copy.

[2] New precision camera calibrator, NBS Technical News Bulletin 33, 8 (1949).

[3] Calibration system for photographic lenses, NBS Technical News Bulletin *31*, 137 (1947); Calibration of photographic lens markings, NBS Technical News Bulletin *33*, 50 (1949).

[4] Extremely wide-angle lenses for aerial mapping, NBS Technical News Bulletin *32*, 5 (1948).

[5] New crystals for infrared spectrometry, NBS Technical News Bulletin *32*, 96 (1948).

CONTROLLERS INSTITUTE ELECTS OFFICERS

C. R. Fay, Comptroller of the Pittsburgh Plate Glass Company, has been elected President of the Pittsburgh Control of the Controllers Institute.

Stanley P. Jones, Secretary-Treasurer of the Northwestern Glass Company, has been named a Director of the Institute's Seattle Control, and Raymond F. Mensing, Secretary, Treasurer, and Comptroller of Glass Fibers, Inc., has been similarly elected by the Toledo Control.

Clyde O. Dawson, Assistant Secretary and Assistant Controller of the Owens-Illinois Glass Company, has been renamed a Director of the San Francisco chapter.

"IF"

Your amber glass flares up occasionally and you experience a loss in production because of seeds, blisters, or color streaks, *or*

If you are having losses directly traceable to batch segregation, such as cords, *or*

If your amber glass is a flat, uninviting brown color instead of a more personable, robust red color, *or*

If you feel your raw material costs are making your batch costs excessive thereby materially contributing to a lower over-all profit picture from your operations, *then*

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DIFFERENT TYPES AND SHAPES MADE ON EISLER'S AUTOMATIC AMPULE MAKING MACHINES
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NEED FOR SAFETY ENGINEERING . . .

(*Continued from page* 461)

4. Biological Fundamentals. (a) Causes of Human Disorders; (b) Mental Hygiene; (c) Social Diseases; (d) Married Life; (e) Socialized Medicine.

5. Codes as applied to (a) Buildings and Structures; (b) Sanitation; (c) Electrical; (d) Fire Underwriters.

6. Labor Laws. (a) Federal; (b) State.

7. Safety. Selections from "Industrial Safety Fundamentals; A Suggested Engineering College Course", presented by The American Society of Safety Engineers (Committee on Cooperation with Engineering Colleges).

8. Industrial Hygiene. Selections from "Occupational Disease Control in the Ceramic Industry", by Karl L. Dunn, Industrial Hygienist, Corning Glass Works.

Summary

In summary, the points which I wish to emphasize are as follows:

1. There is a demand for the teaching, to engineers, of a course in Safety and in Industrial Hygiene.

2. There is room for a three-hour course, as outlined, in our already overcrowded curricula.

3. Engineering Ethics and Practice is the indoctrination medium through which the realization of safety may be accomplished.

4. The safeguarding of the life and the health of our associates is a paramount duty of engineers.

5. The human approach to the teaching of safety is essential.

6. Good teaching by "A Teacher" is required.

CANADIAN GLASS PLANT CHANGES HANDS

Consolidated Glass, Ltd., one of Canada's three largest distributors of flat glass and other related products, has become a public company. The assets and undertaking has been purchased by a new company, Consolidated Glass Industries, Ltd., which remains an independent Canadian company under the same management. The financing has been arranged by Harrison & Co., Ltd., of Toronto, and securities of this company are currently being offered to the public.

Securities being offered consist of $200,000 5% first mortgage serial bonds offered at 100 plus accrued interest and $450,000 5½ general mortgage sinking fund bonds. With each $1,000 general mortgage bond, there are offered 20 shares of common stock, no par value, of an authorized issue of 100,000 common shares, no par value. An issue of $225,000 6% cumulative redeemable preferred has been subscribed for cash by members of the Hobbs family which established the original firm.

• At the monthly meeting of the Board of Directors of Thatcher Glass Manufacturing Company, Inc., a dividend of $.15 per share was declared on its Common Stock, payable September 15 to Stockholders of record of August 31, 1950.

MOLD-SMOKING PROCESS FOR GLASS BOTTLE MOLD LUBRICATION

Mold-smoking is a recently-introduced process for lubricating molds used in producing glass bottles. Cleaning is cut to a minimum. This means that more bottles can be produced before the equipment must be cleaned than is possible with the standard liquid or solid lubricants.

When intricate designs with monograms, letters, or crackle surfaces are being made, the smoke from the mold-smoking blowpipe will not fill up the engraving as quickly as other types of lubricant.

Danger of glass sticking to unlubricated sections of the mold is eliminated because mold-smoking quickly and thoroughly covers the mold with a uniform coating. Another advantage of the process is that the equipment used to coat molds can also be used to lubricate parts of the glass-making machine, such as the take-out arms, transfer plates, and conveyor belts.

Mold-smoking can be defined as a method of lubricating the inner surfaces of a mold with a carbon produced by burning pure acetylene through a lighted blowpipe. The carbon lubricant facilitates the flow of glass into the mold, and prevents glass from sticking to the mold surface upon cooling.

At the same time, the heat of the flame quickly brings the mold up to the correct operating temperature. The molding machine will, therefore, produce perfect bottles soon after the start of operations. On the other hand, liquid bottle lubricants chill the mold and thereby increase the time required.

Apparatus for this application is extremely simple. The "Oxweld" L-24 Mold-Smoking Blowpipe, available through The Linde Air Products Company, is made especially for mold-smoking. The L-24 blowpipe uses medium-pressure acetylene for the soot deposits and a second fuel gas, such as propane, city, or natural gas, as a pilot light to ignite the acetylene and to form a superior-type carbon deposit with the acetylene carbon. No oxygen is used. The blowpipe has a needle valve with fingertip controls for acetylene flow, and a needle valve with slotted stem for screwdriver control of pilot flames. A quick-acting shut-off valve permits quick stops and starts with no loss of time or of gases. Other features of the L-24 Blowpipe include a sturdy ribbed handle permitting a firm hand grip, and a smoke tube over the tip, aiding in the obtaining of type deposit desired.

The blowpipe will produce practically any type of carbon deposit desired, from a heavy soft black to a harder form, grey in color. For glass bottle molds, a heavy soft black carbon deposit produces the best results. This type of deposit can be obtained by unscrewing the smoke tubes in the blowpipe tip several turns or by holding the tip close to the workpiece.

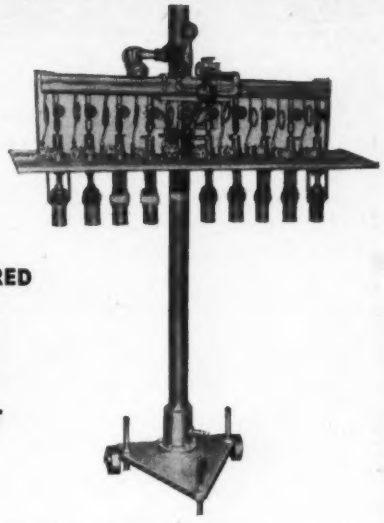
While there is no standard operating procedure that pertains to all applications, generally one slow, steady pass of the blowpipe will be sufficient to procure the desired coating. In mold-smoking work, gas consumptions are moderate. Average acetylene consumption is approximately 32 cu. ft. per hour; secondary fuel gas consumption is less than half of this figure.

• John B. Powell has been appointed Manager of the Engineering Division of General Electric Company's Apparatus Department, New England District.

OIL FIRED BOTTLE POLISHER

for

Beers
Beverages
Containers



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...because
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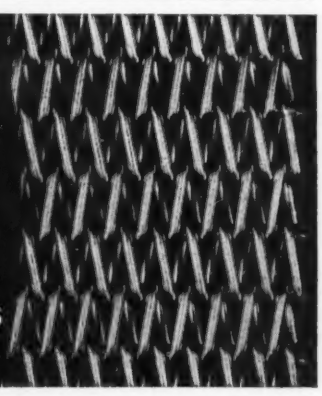

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